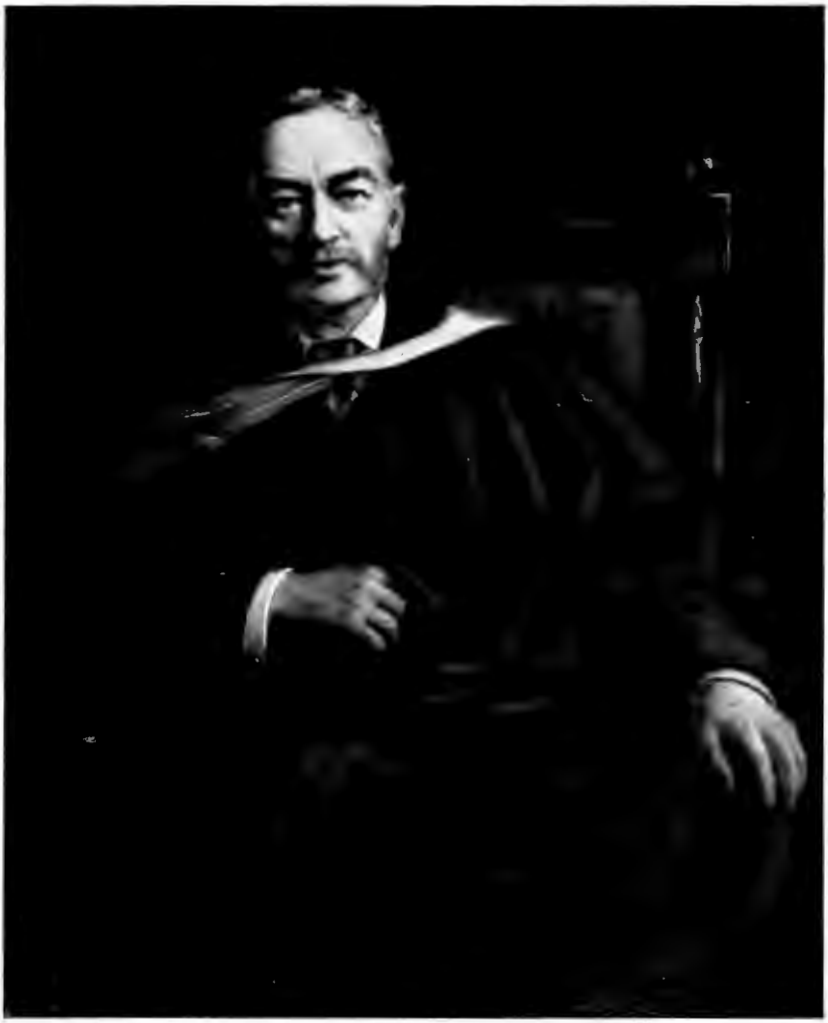
EARLY ENGINEERING EDUCATION AT TORONTO
1851–1919



JOHN GALBRAITH, M.A., LL.D.
1846–1914
Portrait by J. W. L. Forster

EARLY ENGINEERING EDUCATION AT TORONTO

1851-1919

C. R. YOUNG

University of Toronto Press

PREFACE

INDIFFERENCE TOWARDS THE LABOURS of those who strove long and resolutely in the creation of our institutions of learning appears to be an inherent characteristic of human nature. More often than not, the resultant benefits are accepted by the public as if they had come painlessly out of uneventful daily routine.

Dr. Cyrus Macmillan observed many years ago that the story of McGill University was one of struggle and disappointment, of discouragement and controversy, and of ultimate success and triumph. He added that students who enjoyed the advantages of a great seat of learning were not always conscious of the toil and the anxiety, the weariness and fret of its early years. It must be admitted that there are few existing educational institutions of which this might not be equally said.

In the hope of contributing something in remedy of the neglect, the author has undertaken to tell the story that follows. That such narratives are needed is apparent when one realizes that only a few of the schools of professional engineering in Canada have made substantial efforts to record their early histories. In many instances the available material is limited to calendars, minutes, and reports, devoid of colour, and with little concerning the personal characteristics and impact upon their institutions of those who bore the initial responsibilities and suffered the disappointments of precarious beginnings. The establishment and maintenance of archives having biographical significance is a duty owed by every educational institution to its graduates and friends.

Professional schools of engineering must be said to have come into being and thriven despite the apathy, and even active opposition, that attended their founding. Resistance came primarily from the hostility of the traditionally educated classes to engineering pursuits in general. John Smeaton, the first to be designated in

English-speaking countries as a "civil engineer," was severely upbraided by his fellow members of the Royal Society of London for undertaking the "navvy work" of building a road across the valley of the Trent River. When, in 1840, a chair of Civil Engineering and Mechanics was established in the University of Glasgow, a campaign was actively waged to have the obnoxious thing suppressed. Faced with the impending introduction of engineering courses at the King's College of New Brunswick, the President of the College enjoined his hearers in 1851 to resist a movement that threatened to "call them from the pursuit of truth and virtue to the lower paths and grosser occupations of the multitude." As late as 1922, when the School of Chemistry was getting under way at Laval University, anxious persons spoke of it as threatening to become "a veritable cancer in the University."

The times in which such comments might be heard are rapidly receding. So great is the acknowledged contribution of the engineer to the welfare and security of the free world that his scientific technology has earned a place in the realm of learning not inferior to that occupied by the virtual technologies of advanced studies in the humanities and pure sciences. A development of scholastic training that has enabled the engineer to play his appropriate role in human undertakings with efficiency, and often with great distinction, should be worthy of historical record.

To those who in one respect or another have assisted him the author conveys his grateful thanks.

C. R. Y.

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I

ENGINEERING EDUCATION BEFORE 1851

MORE THAN A HUNDRED YEARS AGO the national value of technological education of professional grade was so firmly established in Europe and the United States that measures for furthering it in Canada became inevitable. The initial organizational step in that direction was taken in this country at the University of Toronto in 1851.

France, already pre-eminent in the arts, was first to realize that effective application of the technical sciences to creative planning, design, construction, and production could come only by the selection and training of a special personnel charged with such tasks.

Action in conformity with this belief was taken by Louis XV in 1747, on undertaking to repair the fortunes of his country, which had suffered grievously from the waste and extravagance of his predecessor. In furtherance of his plan, which involved the construction of a vast system of national highways, he charged his engineer, Perronet, to see that all persons appointed to posts having to do with surveys, designs, and construction of bridges and roads were instructed in the sciences and practices needful to fulfil with competency the different occupations incidental to such work. In carrying out his instructions, Perronet established, in effect, the first engineering school and thereby became the father of engineering education. Although it was made immediately operative, the school was not officially recognized until 1775, when it became the justly celebrated Ecole des Ponts et Chaussées.

Meanwhile, the teaching of mining and metallurgy had begun in 1765 at Freiberg, in Saxony, through the establishment of what was to be by the middle of the nineteenth century a school of international renown, largely attended by foreigners, the Bergakademie. France followed, in 1783, with the Ecole des Mines, successor to an earlier school established at the Paris mint in 1778.

Although several technological schools of professional grade had thus been operative in Europe well before the end of the eighteenth century, the creation of institutions of this type in Britain was long delayed. The Continental idea of developing a body of professional engineers, soundly trained in the science of the time, for the planning and direction of public works and industry had no discernible repercussion there. This was not remarkable. British industry had grown phenomenally through the inventions of workmen who seldom had more than a rudimentary acquaintance with science. Traditionally, the engineer was a practical man of little formal education who had by dint of observation and private study acquired some knowledge of the science underlying his art.

For more than a century after the foundation of the first professional engineering schools of Europe, Britain confined her technical educational effort largely to the incidental teaching of science to workmen, and that for the most part as a welfare movement. However commendable this might have been in certain respects, it failed to meet the problem of providing well-trained, selected young men to assume creative leadership in technological undertakings. That was left almost wholly to the system of indenture and pupilage. While, at its best, this arrangement gave good results, it was often open to abuses. In many cases the pupil acquired little more than a set of empirical rules and a knowledge of precedent. More often than not it was associated with the view that exact science had but slight relation to engineering. It was the wasteful and often dangerous method of rule of thumb, of trial and error. Delay in the development of an effective system of technical education arising from these circumstances probably deprived Britain of fifty years of her lead over Germany, where educational and industrial advancement had been amazingly rapid.

With this tradition, it was natural enough that the first step taken in Britain in the direction of technological education should be the provision of lectures in science for industrial workers. Through the munificence of John Anderson, Professor of Natural Philosophy in the University of Glasgow, there was established in Glasgow, in 1796, an institution known as Anderson's University, dedicated to "the good of mankind and the improvement of science." In it, the benefits of popular scientific education were made available to the public, without qualification. Although Anderson's College, as it

came to be known later, was not a professional school, as we now understand the term, it represented the first organized effort in English-speaking countries to provide regular instruction in applied science to persons interested in the practical arts. Ninety years later the College merged with three other institutions and its legacy and tradition still survive in the Royal Technical College of the University of Glasgow.

Not until the nineteenth century had well advanced did any significant change occur in the method of imparting professional training to engineers in the British Isles. In the first fifty years of the century the traditional system of training by pupilage was supplemented to a limited extent by theoretical study in mathematics and natural philosophy at one of the older universities. Schools of engineering were established at University College, London, in 1828; at King's College, London, in 1838; at the University of Glasgow in 1840; and at Trinity College, Dublin, in 1842. These met with only partial success, and many more years were to elapse before any really significant advance occurred. Their comparative ineffectiveness arose in part from the ill-disguised hostility of those having to do with traditional literary and philosophical studies. Thus, when the professorship of Civil Engineering and Mechanics was founded in the University of Glasgow, a vigorous campaign was waged to have it suppressed.

But the disabilities of these schools arose rather more from the fact that the great majority of practising engineers, wedded as they were to the pupilage system, did not look upon the acquisition of theoretical knowledge as an essential part of a young man's training. The ground taken was that engineering was an art rather than a science. The educational foundation given in the schools of engineering was therefore deemed to be at most only mildly auxiliary. Even men of the eminence of Rankine and Fleeming Jenkin were sometimes spoken of as merely "hypothetical engineers."

Despite this unfortunate tardiness in realizing the national value to Britain of technological education of professional grade, progress was outstanding in the years that followed the period under consideration in this chapter.

A marked stimulus to the development of technical education in Britain came from the Great Exhibition held in London in 1851, under the sponsorship of Albert, the Prince Consort. That notable

event directed public attention to the possibilities of scientific invention and scientifically directed industry. Although native inventive genius and business enterprise had given the country a fifty-year lead in the race for the economic supremacy of Europe, it was with not a little shock that the British learned from the Exhibition of the startling progress that had been achieved by their Continental rivals through superior organization of scientific research and education. A qualified British observer admitted that his countrymen had often been more concerned with the elegance of the finish and perfection of workmanship of their machines and products than with the correct design of their parts.

One result of these revelations was the utilization of the profits of the Exhibition to create agencies for the instruction of those engaged in the arts and manufactures, and to project a great applied science centre at South Kensington. Another benefit, which has long been enjoyed by Canadian science students, was the founding of the Exhibition of 1851 Science Research Scholarships. In addition, the government, lacking a national educational authority, established a Science and Art Department under the Board of Trade in 1853 to recover, if possible, the educational leeway that Britain had lost.

It is significant that the year of the Great Exhibition was the year in which the first definite step was taken in Canada towards the provision of facilities for professional engineering education. That came in the establishment of a chair of Civil Engineering in the University of Toronto.

While basic sciences and civilian engineering subjects were taught in the military academies of the United States as early as 1819, technical education for civilians originated in a popular movement to promote "the application of science to the common purposes of life." Its goal was to give farmers and mechanics such scientific education as would enable them to become skilful in their work.

Following the unsuccessful venture of 1822–24 at Gardiner, Maine, known as the Gardiner Lyceum, came the first school of continuous existence offering instruction in professional engineering subjects in an English-speaking country. It was the Rensselaer School, at Troy, New York, set up in 1824. Inspiration came largely from French sources. From the beginning, certain civil engineering subjects appeared in the curriculum, and in 1835 the first degrees in Civil Engineering were granted. In 1849 the School became known as the Rensselaer Polytechnic Institute.

With almost dramatic suddenness, the vision of the founder of the Rensselaer School was justified. In the years preceding the historic venture of Stephen Van Rensselaer, engineering in the United States had of necessity been entrusted to ingenious mechanics, with such aid and direction as could be secured from a very few engineers, either self-taught or trained abroad. Under such circumstances the roads, canals, bridges, water wheels, engines, and machinery of that day were built. But with the coming of the railroads and the intensifying urge to occupy the lands farther and farther removed from the Atlantic seaboard, the demand became imperative for the services of surveyors, engineers, and constructors with a superior mastery of their arts. The need could not have been met within the available time from private study and the limited facilities for pupilage in a country that had few members of the engineering profession to whom novices could be articled. The emergency was met in the only way in which it could have been met—by inaugurating scholastic training in professional schools.

The success attained at Rensselaer led to similar action elsewhere. Union College, Schenectady, introduced civil engineering subjects into its curriculum in 1845. Harvard and Yale took steps in 1847 to set up schools of applied science. Dartmouth, with its Chandler Scientific School, followed in 1851. At the University of Michigan instruction in engineering began in 1852. The Massachusetts Institute of Technology did not, however, commence operations until 1865.

By 1850 there had come to the Maritime Provinces a definite realization that something should be done towards providing facilities for practical scientific education. President George McCawley, of King's College, Windsor, Nova Scotia, had begun what were to be repeated urgings for the establishment of a chair in Natural History and Experimental Philosophy. A year later, he drew the attention of the Governors of the College to the need for keeping pace with the ages in these terms:

> We are lagging far behind the age in a knowledge of the sciences, in those particularly which discover secrets of nature and apply them to the service of mankind. Without some addition to our staff we shall soon be remarkable for our ignorance of the Arts and Sciences, which now so much engage the attention and promote the comforts of the civilized world. The youth of these Provinces seem to be as capable of receiving instruction and distinguishing themselves in scientific pursuits as the youth of Europe—but in this Province we are almost destitute of proper instructors in Natural History, Physiology,

Botany, Chemistry, Geology, and Metallurgy, rich as we are in mines and minerals. It is the obvious duty of the Governors, as soon as practicable to supply[?] this serious defect.

King's College of New Brunswick, Fredericton, which had been incorporated by Royal Charter in 1800 to meet the needs of the impoverished refugee Loyalists from New England, was beset by a strong outside demand for technological education before the end of its first half-century of existence. To qualified observers, it was clear that the College was not meeting the challenge. Most of its critics, and they were numerous and clamorous, contended that the existing classical curriculum was unsuited to students who would have to earn their living in New Brunswick. One editor put it this way:

To be intimately and critically acquainted with the writings of the philosophers, historians, and poets of Greece and Rome is a luxury confined to the aspirations of the few—not a necessity for the many. The many of this fast and labouring epoch look for knowledge that contributes relief to the wants, and will meet the exigencies, of the passing hour. Mental life in a new country cannot afford the time required to detect the subtleties of the Areopagitica, or to elaborate the conceits of a Sappho, or wade through the nonsense of a fabulous mythology. The present is overloaded with the practical.[1]

Notwithstanding the absence of a cultured or leisured class in the Province, the President of the College refused to consider changes which practical-minded members of the Legislature wished to introduce in order to widen its appeal and to enable it to serve better the immediate needs of the people. In 1851 he proclaimed his belief that intellectual or moral culture could not be attained in practical courses, and added:

To those who would make the college a polytechnic institution we may not promise much more in the way of merely practical teaching; we must not listen to the cry which calls us from the pursuit of truth and virtue to the lower paths and grosser occupations of the multitude. . . .[2]

But despite the strongly contrasting views of the traditionalists and the realists of the Maritime Provinces, significant steps in the direction of the technological education were to be taken very soon.

[1]*The University of New Brunswick Memorial Volume* (1950).
[2]*Ibid.*; see also John B. Stirling, *The First Hundred Years: Being the Founders' Day Address, University of New Brunswick, February 15, 1954.*

2

THE UNIVERSITY COLLEGE VENTURE

BEFORE THE NINETEENTH CENTURY was half spent many of those Canadians who were alertly interested in economics and practical affairs had come to realize the importance of science and technology in the development of the natural resources of a country. Ample evidence of that vital relationship existed in Europe and in the United States. British industry was acutely conscious of it through the rapidly developing competition of continental Europe, based upon the superior technology of France and Germany. At the same time, the need for more well-trained engineers was arising in Canada, where less than a hundred of them were to be found in all the country. As yet, the demand was associated largely with works of transportation, such as waterways, canals, harbours, roads, railways, and bridges, but visions of a splendid and expanding field in the actual utilization of the natural wealth were persistently recurring.

In Upper Canada the time was ripe for educational action. Under the so-called Baldwin Act of 1849 (12 Vict., c. 82), which effected the transformation of King's College into the non-sectarian University of Toronto, the way was opened for the establishment of such chairs as might be deemed desirable by the authorities having jurisdiction. A Commission of Visitation, consisting of not less than five persons, had been authorized, with power to confer with the authorities of the University upon such alterations and amendments in statutes, rules, or ordinances as it thought proper to recommend for this purpose, and generally for the well ordering of the University. The Act became effective on the first of January, 1850, and under it five Commissioners were appointed. They were the Honourable William Hume Blake, Chancellor of Upper Canada and father of Edward Blake, the Honourable John Hillyard

Cameron, Q.C., M.P.P., John Wilson, M.P.P., David Buchan, and James Henry Richardson, M.R.C.S. John Burns was Secretary.

With a view to informing itself of existing views on the subject the Commission issued a circular on January 28, 1851, seeking opinions concerning desirable changes.[1] It announced that those which had been most pressed upon its attention as immediately necessary to the efficiency of the institution, and possibly attainable with the income available, were a Professor of Natural History, one in Modern Languages, one in Agriculture, and a School of Engineering.

The detailed nature of the replies received by the Commission is unknown. Evidently the idea of a School, or Department, of Engineering found favour, for in midsummer of 1851 the Caput—the body charged with the government of the University in subordination to the Senate—took steps to fill the chair of Civil Engineering that had already been established by the Commission.[2] In conformity with a Visitorial Statute, notice was given by public advertisement that applications, addressed to the Caput, would be received for the professorship of Civil Engineering at the Bursar's office on or before November 19, 1851. According to the Caput's report of January 23, 1852, signed by President John McCaul, this was the first of the chairs established by the Commission to be taken under consideration by the Caput.[3]

The report, laid on the table of the Senate on January 24, dealt with the applications for the position submitted up to that date. Five of these, with testimonials, had been received within the appointed time. They were from William Armstrong, George Herrick, J. G. B. Marshall, J. Tully, and Kivas Tully. A sixth application, without testimonials, came from a Mr. Semper.

On the basis of the relative value of the testimonials submitted, the Caput listed the applicants in the order of preference thus: Marshall, Herrick, Armstrong, J. Tully, and Kivas Tully. Semper's application so much impressed the Caput that, despite the absence of testimonials, it recommended him for inclusion in the list, under the authority of the 1850 amendment to the Baldwin Act (13 Vict., c. 49).

[1]*The Church*, March 6, 1851, p. 252.

[2]Province of Canada, Legislative Assembly, *Journals*, 1852–53, Part 2, Appendix L; Public Archives of Canada, P.S.O. Can. W., 1853, vol. 375, no. 19.

[3]Public Archives of Canada, P.S.O. Can. W., 1853, vol. 375, no. 19.

Marshall, the first choice, was a graduate in Civil Engineering of the University of Dublin and Professor of Mathematics, Surveying, and Civil Engineering in the Royal Agricultural College, Cirencester, England. He had held responsible posts in England in connection with railway and survey work.

But the proceedings were to be greatly complicated and protracted by the late receipt of a seventh application from one who was subsequently to bulk large in the life of the Province. On February 2, 1852, Frederick W. Cumberland applied for the chair, stating that by reason of duties devolving upon him as Secretary of the Provincial Industrial Commission and inducing his presence at the Exhibition of All Nations as a Commissioner from the Province of Canada, he had up to that time been precluded from making application. While aware that in applying at so late a date he was departing from issued instructions, he pleaded consideration on the ground of public honorary duty of acknowledged importance to the Province.

Cumberland had studied engineering for three years at King's College, London, but as the Department of Applied Science there had not been fully established, and no degrees were being granted, he withdrew to complete, as was the practice, his professional education in the office of an engineer. From 1836 to 1841 he studied with William Tress, of London, being engaged particularly on railway surveys. Two years of railway construction under other engineers followed, and then six years of widely varied engineering work with the Admiralty. Coming to Canada in 1847, he engaged in civil engineering and architectural practice, which was to continue for eleven years. This practice had incidentally included, prior to his application for the academic post, some service as engineer to the County of York.

Anticipating possible difficulty, Cumberland requested that should lateness of his application constitute an impediment to the action thereupon by the Caput, it be referred to the consideration of the Senate.

Notice was given in that body by Dr. Lucius O'Brien on February 14, 1852, that at the meeting to be held on March 6 he would move that the application and testimonials of Cumberland in relation to the chair in Civil Engineering be taken under consideration. The motion does not appear to have been made on that date, nor at

the adjourned meeting of March 13. On the latter occasion, however, a resolution was adopted requesting the Caput to transmit to the Senate the names, applications, and testimonials of any person, or persons, who may have been a candidate, or candidates, since the date of their report upon the chair of Civil Engineering (January 23), and to state the peculiar circumstances, if any, attending such application, and also whether it was the intention of the Caput to make any supplemental report on the subject; and if it was not their intention so to do, then to state the reasons for not so doing.

At the meeting of March 20 the President, on behalf of the Caput, transmitted to the Senate: the application and testimonials of Cumberland; the legal opinions of the Honourable Robert Baldwin, the Honourable J. Hillyard Cameron, and Dr. Skeffington Connor, Solicitor to the University, as to admissibility; and a letter addressed to the Caput by William Armstrong, one of the candidates for the chair, protesting against the admission by the Caput of Cumberland's papers. But pronounced misgivings concerning the legality of the proceedings in course were entertained by some members. Later in the meeting, the Senate resolved that the case prepared in behalf of the Caput for the opinions of counsel as to the power of the Caput to make a supplemental report and otherwise referable to their powers with regard to the reporting on the names of candidates for chairs in the University, with any other points that might be suggested by the Solicitor as to the powers of the Senate or Caput, be referred to the regular law officers of the Crown for their joint opinion. That opinion, written by the Attorney General, was laid before the Senate on May 12. In the light of subsequent events it appears to have been favourable to admission of the papers in question.

Not until August 3 did the matter come before the Senate again. On that date a resolution was passed, after an amendment to forward only the names of Marshall, Herrick, and Armstrong to the Governor-General as eligible persons had been lost, to transmit to the Caput for its consideration and report Cumberland's application, his testimonials, and the opinion of the Attorney General.

The Caput dealt succinctly with the Senate's request of August 3. On August 18 it returned the papers under review to the Senate, recommending that Cumberland's name be added to the list of

candidates already submitted, and stating that in its opinion the testimonials afforded satisfactory evidence of his qualifications.[4]

Finally, after nine months spent in discussing procedure and the respective merits of the candidates, the Senate resolved on December 18, 1852, to forward to the Governor-General, as its list of three candidates required by statute, the names of Cumberland, Herrick, and Marshall. From this he might select one candidate for appointment. It declined, however, to express any opinion on the respective merits of the three contestants.

The persistence shown in Cumberland's case no doubt arose from the fact that he was a particularly desirable candidate. The estimate made of his qualifications and potentialities by his friends in the Senate was well borne out by the events of later years. He became chief engineer of the Ontario, Simcoe and Huron Railway in 1852, and on its reorganization seven years later as the Northern Railway of Canada, he was appointed its managing director. In the interval, his firm, Cumberland and Storm, served as the architects of what is now known as the University College building of the University of Toronto. Immediately after Confederation, Cumberland served a term as member of the Legislative Assembly of Ontario, and in 1871 became a member of the House of Commons of Canada.

What consideration was given by the Governor-General, Lord Elgin, to the panel of names submitted by the Senate for choice in filling the chair of Civil Engineering is not known. No appointment was made, and no reasons for the failure to appoint are on record.

Contributory to the long delay that occurred in dealing with the applications for the post, was the questioning by the Senate of the power of the Commission of Visitation to originate professorships and attach salaries to them. At its meeting of August 3, 1852, the Senate resolved to inform the Governor-General that the delay in passing resolutions respecting certain chairs arose partly from doubts concerning the power mentioned. As was to appear later, that doubt was not shared by the Government.

Although no qualified engineering staff was in sight to take charge of instruction in Civil Engineering, the University authorities nevertheless proceeded to make collateral preparations. For example, the Senate on August 14, 1852, approved a clause in a

[4] *Ibid.*

statute whereby scholarship benefits might be secured to students in the School of Engineering as well as to those in other courses. A statute, passed on April 8, 1854, provided that of sixty scholarships in the Faculty of Arts, having a value of thirty pounds each, five were to be available to students in the Department of Civil Engineering.

Meanwhile, on March 24, 1854, the Senate referred to an existing committee the question as to whether any, and what, encouragement could be held out to induce students in Medicine, Law, Civil Engineering, and Agriculture to take degrees in Arts, or become students in that Faculty. Six days later a report on the matter was presented and adopted, but the unfruitful nature of its findings and recommendations may be deduced from the absence of any relevant action on the part of the Senate.

Another year passed. On February 8, 1855, the Vice-Chancellor (President McCaul) moved the first reading of statutes relative to the requirements for diplomas in Medicine, Civil Engineering, and Agriculture. On April 3 the statute respecting Civil Engineering was passed, the mover being Frederick W. Cumberland, who had become a member of the Senate in 1854. It was further resolved that the matriculation examinations for students in Civil Engineering should commence in the last week of September.

The report of the Senate of the University for the calendar year 1855 announced the significant development of a systematic course of examination in the several departments of academic study.[5] Amplifying, it continued:

> In this important work, they not merely regarded the usages of the ancient Universities of Great Britain and Ireland, but also carefully considered the improvements which have been adopted in those of more recent date. Nor did they omit inquiry into the systems pursued on the continent of Europe, in the United States of America, and in Nova Scotia and New Brunswick, their object being to derive from every source which was accessible to them such suggestions as might contribute to the production of a general plan suitable to the circumstances of the Province. The result of their deliberations has been the completion of progressive courses of examination not merely in the faculties of Law, Medicine and Arts, but also in the departments of Civil Engineering and Agriculture. . . .

It is evident that the activities of the Senate had in some measure been stimulated by what had been going on in the Maritime

[5]Province of Canada, Legislative Assembly, *Journals*, 1856, vol. XIV, Part 1, Appendix 11.

Provinces. Much was happening there educationally that might well engage its attention. At King's College, Nova Scotia, the urgings of President McCawley towards the introduction of the physical sciences were gradually taking effect. In 1855 Henry How, of Glasgow, was appointed Professor of Chemistry and Natural History. Fortunately he was well grounded in Mineralogy, a qualification that led to his frequent employment by the Provincial Government to report on various occurrences of minerals and ores. Incidentally he made many analyses and assays of a practical character, an activity which was really in the field of the geological or mining engineer.

Notwithstanding the hostile attitude of the President of King's College of New Brunswick to practical courses, there had been about him others who discerned that the immediate need of the Province was to provide a sustaining basis for the culture that the classicists so earnestly desired. These advisers believed that an education with useful practical facets might be made available with advantage to many young men whose interests and abilities were definitely related to the physical world about them.

Able leadership in applied science training had been afforded by Dr. William Brydone Jack, a Scot, who had come to the College in 1840 as Professor of Mathematics, Natural History, and Astronomy. As one of his duties was to give instruction in Mechanics and Pneumatics (including the steam engine), his work lay, in part, within the territory of the engineer. Moreover, he gave some lectures in Surveying, as part of the Mathematics course, and appears to have done some field work.[6]

It was fortunate too, that in the early fifties the Lieutenant-Governor of New Brunswick was Sir Edmund Head, a man of marked ability, imagination, and foresight. His seven years as a Fellow of Merton College, Oxford, had given him a solid basis for the appraisal of educational problems.

Sir Edward was definitely receptive to the ideas of Brydone Jack. As a result, he became a strong advocate of a course in engineering, and in 1852 urged the merits of it on the Chancellor of the College. A Commission was set up and reported that, amongst other things, "more specific attention might be given to Civil Engineering." Thereupon, a College statute was enacted on April 2, 1853, autho-

[6]*The University of New Brunswick Memorial Volume* (1950).

rizing the appropriation of funds "to defray the expenses of lecturers and practical instruction to be given in Civil Engineering and Drawing."[7]

Advertisements relating to this work appeared in the press on December 10, 1853; the initial lecture, delivered on February 15, 1854, by McMahon Cregan was the first formal instruction in professional engineering given in an academic institution in Canada. The lecturer was an English engineer who had been brought out to conduct a survey for the European and North American Railway, a line that was to connect Halifax with Portland, Maine, *via* St. John, N.B. Following the plan of operation, Dr. Brydone Jack laid down the necessary foundation of mathematics during the autumn months, and Mr. Cregan taught the engineering subjects during about two and a half months of winter, when it was impossible to do field work on the railway survey.

But competing activities in the applied science field were developing much closer to Toronto. The marked public interest in technological and engineering training that grew out of the 1851 Exhibition in London, England, had its repercussions at McGill University, as it did at the University of Toronto. Thoughtful men, interested in the promotion of the economic welfare of Canada, had wondered if something tangible in this direction could be done in Canada East. Montreal appeared to be an eminently favourable site for a beginning.

It was natural, therefore, that John William Dawson, newly appointed Principal of McGill, should forge the first link of the long chain of events that led to the eminence of his university in the field of professional engineering education. A few days after inauguration in November, 1855, he announced a course of thirty popular lectures in scientific subjects, including Civil Engineering. Out of this modest beginning eventually came the Department of Practical and Applied Science, early forerunner of the Faculty of Engineering at McGill.

Stimulated by this substantial background of similar activity elsewhere in Canada, the movement to inaugurate some form of applied science instruction at the University of Toronto was hastened. A return made to the Legislative Assembly of United Canada for the year 1855 contained a detailed statement of the requirements

[7] *Ibid.*

for obtaining the diploma in Civil Engineering that had been adopted by the Senate of the University on April 3, 1855.[8] In brief they were:

> Having passed an examination in the subjects appointed for candidates for matriculation in Civil Engineering; being of the standing of two years from matriculation, and having passed in each of the years an examination in the subjects prescribed for each such year of the course appointed for students in Civil Engineering.

Matriculation requirements included, for Mathematics, a standing in Arithmetic, Algebra, Euclid (Books I to IV, and the definitions of Books V and VI), Logarithms, and Plane Trigonometry. The prescribed Natural Philosophy included Mechanics, Hydrostatics, Hydraulics, Pneumatics, Acoustics, Optics, and Astronomy. In addition there were: Elements of Chemistry; Elements of Mineralogy, Geology and Physical Geography; English and French; English and Ancient History; Geography; Drawing. It is apparent that a substantial general education, with an emphasis on mathematics and science, was expected of the entering student.

The curriculum for the first year comprised Euclid and Descriptive Geometry; Statics, Dynamics, Hydrostatics; Chemistry; Geodesy and Drawing; English and French; History. In the second year were included: Spherical Trigonometry and Stereotomy; Optics; Applied Chemistry; Mineralogy and Geology; Physical Geography; Civil Engineering, including Principles of Architecture and Engineering Finance; Drawing; English and French; History.

Evidently the coverage of professional Civil Engineering subjects in the comparatively small amount of time allotted to them, and that confined to the second year, would have been very thin.

Although the Senate of the University had in 1855 set out in detail the subjects of examination prescribed for both matriculation and a two-year undergraduate course, it was not until two years later that actual instruction became available. Under the Act of 1853 (16 Vict., c. 89), no kind of teaching could be undertaken by the University itself. It had to be assumed by University College, that is, by the Faculty of Arts, the only faculty then existing.

In 1857, University College announced that it had adopted the courses prescribed by the University of Toronto and that it would give the lectures appointed for candidates for the diploma in Civil

[8]Province of Canada, Legislative Assembly, *Journals*, 1856, vol. XIV, Part 1, Appendix 11.

Engineering. The calendar of the College for 1857–58 contained the first formal offering of a complete course of study in Civil Engineering made in what is now Ontario. There is no evidence, however, that any student entered upon it until 1859.

While the entrance requirements differed in several respects from those that had been prescribed by the University in 1855, they were more exacting in Algebra and Euclid than those for matriculation in Arts, but less so in Languages, History, and Geography.

The curriculum for the two years that were to be spent in University College was largely determined by the necessity that it interlock with the Arts curriculum. The small numbers that were likely to enrol in Civil Engineering would not have justified special lectures, except in a few unavoidable instances. Consequently, the course of study actually offered for the first year was not entirely the same as had been suggested in the statute of the University Senate passed on April 3, 1855.

In the first year it comprised Mathematics and Natural Philosophy; English; French; History; Chemistry and Chemical Physics; Elementary Mineralogy, Geology, and Physical Geography; Geodesy and Drawing. The second year included Mathematics and Natural Philosophy; English; French; History; Applied Chemistry; Mineralogy, Geology, and Physical Geography; and Civil Engineering, including the Principles of Architecture and Engineering Finance, Practical Use of Instruments, and Drawing.

While only minor modifications were made in the requirements for admission to the Civil Engineering course during the twenty-six years of its existence, substantial alterations were made in the course itself. In 1860, the first-year subjects of Geodesy and Drawing that had been required for those proceeding to the engineering diploma were deleted. Already, in 1859, the curriculum of the second year had undergone modification by the dropping of the applied subjects of Civil Engineering, including Principles of Architecture and Engineering Finance, Practical Use of Instruments, and Drawing. Descriptive Geometry was added to the second-year programme in 1879, probably because this subject was included in the curriculum of the School of Practical Science, which was then offering a competing three-year diploma course on the University campus.

The elimination of distinctive Civil Engineering subjects in the first and second years, only three years after the offering was first made, was in all probability a consequence of the failure to appoint

a Professor of Civil Engineering, for no member of the teaching staff of University College was qualified to give instruction in Civil Engineering subjects. Dr. E. J. Chapman, Professor of Mineralogy and Geology, had some experience in Civil Engineering work, but it was inadequate for this task. Students were forced to rely on the prescribed texts and such instruction in engineering technology as they could obtain outside the University. Numbers of them from the Department of Civil Engineering received instruction in Drawing in the downtown non-professional School of Practical Science in the middle seventies and did very well at it.

A definite effort was made, however, to orient the course of study in the direction of Civil Engineering and to establish a standard of professional knowledge by the appointment of external examiners. During a fifteen-year period some notable engineers served in that capacity. Sandford Fleming acted for four years, Thomas C. Keefer for three, and Alan Macdougall for four. Several others served for shorter terms. But the most significant appointment, from the standpoint of engineering education in Canada, was that of John Galbraith, for the years 1877, 1878, and 1879, after he had served as an examiner in Mathematics for 1874 and 1875. It is not known whether in undertaking the work in 1877 and 1878 he entertained any thought of the important appointment that awaited him in the autumn of the latter year, and the commanding role hat he was to play for many years in the field of engineering education in Canada.

Judged by the numbers of students enrolled, the Civil Engineering course in University College could scarcely have been termed successful. The first matriculants were F. H. Braithwaite, George McKenzie, and C. F. G. Robertson, who qualified for admission in 1858. Thereafter, the admissions to the course were few and irregular. The largest annual number appears to have been four, and often there was none. For the twenty-six years in which the course was available, there were only seven who received the two-year diploma. They were, with their years of graduation:[9] C. F. G. Robertson, 1861; W. G. Bellairs, 1862; G. C. Brown, 1867; H. Kippax, 1870; B. Irwin, 1872; F. W. Christie, 1877; and H. B. Proudfoot, 1878.

As the years passed, it became evident that the technological needs of the Province were not being fully met by the University College course as it existed. In the Senate it was resolved on November 2, 1869, that a Committee consisting of Vice-Chancellor

[9]W. J. Loudon and W. F. McLean, *Fasti, 1850–1887* (Toronto, 1887).

Adam Crooks, President McCaul, Dr. W. T. Aikins, Professor J. B. Cherriman, and Mr. G. R. R. Cockburn "draft a petition to the Legislature of Ontario to pass an Act for the establishment of a School of Mines and Mining Engineering and Museum of Practical Geology and Mineralogy in connection with the University."

On December 3 the Vice-Chancellor reported a recommendation of the Committee that inasmuch as the proposed step would involve an appropriation of public funds, the views of the Provincial Government should be ascertained and the matter brought to its attention before any petition was addressed to the Legislature. The Senate adopted the recommendation and requested the Vice-Chancellor and the President to bring the matter to the consideration of the Government. It appears that the latter was not impressed by the proposal, at least as regards the suggested association with the University of Toronto. Two years later the John Sandfield Macdonald administration appropriated funds for setting up a School of Technology entirely divorced from the University. In it, not only the facilities requested by the Senate's Committee, but others as well, were to be made available.

Indicative of the efforts made on behalf of the University to have a School of Mines associated with it was a letter addressed to Sir John Macdonald by the active and influential engineer and railway contractor Casimir Stanislaus (later Sir Casimir) Gzowski, on November 6, 1870. After speaking of the important role that a School of Mines could play in the development of the mineral resources of the country, he observed that there was no competent authority to examine, report on, and direct mining operations, and for want of proper guidance money had been wasted and work abandoned. He continued:

> Our University, with its excellent laboratory, forms a nucleus for such a school. A small grant to make things more suitable to mining and analytical chemists in connection with minerals, and a museum for mining samples, with an annual subsidy for a professor's chair, and to cover annual explorations of mines worked and deposits, with students in advanced classes, will be all that will be required. The benefits will be very great.

In reply, Sir John pointed out that as all the mineral lands belonged to the provinces, it was a function of the provincial governments to develop their own mining interests. Since the Geological Survey appertained to the Dominion, the Dominion Government was willing to provide facilities for a School of Mines to be

established on the premises occupied by the Survey at Montreal, on the condition that the different provinces should contribute to the cost of the teaching and maintain the School in a state of efficiency. Out of this proposal was to come, some two years later, the Division of Assaying and Mining within the Faculty of Arts at McGill University.

Nearly ten years of uncertainty and indecision respecting the future of the Department of Civil Engineering in University College followed the acrimonious debates of 1871 in the Legislature. In that exchange, the Opposition, under Edward Blake, bitterly fought the Government's proposal to set up the School of Technology. As originally conceived, it no doubt would have amounted to a rival of the University, in so far as engineering education was concerned. And so, harsh things were said by members of the Government concerning the alleged failure of the University to serve the Province adequately in this respect. What they were, will be seen in the next chapter.

Relative calm set in when, on the defeat of the Sandfield Macdonald Government late in 1871, the Blake administration declined to proceed with the plans for a rival in the field of professional engineering education. For five years it contented itself with the tentative operation of a non-professional school for artisans in downtown Toronto. Naturally, while the Government policy was maturing, no important changes were made in the University College course. The matter of degrees in Applied Science was considered by a committee of the Senate, but no action appears to have been taken.

When the Mowat Government realized that the School of Technology and its successor, the downtown School of Practical Science, were unable to provide more than a very elementary and fragmentary training, and had reached the decision to set up a new professional school in co-operation with the University of Toronto, the withdrawal of the University College course became inevitable. Nevertheless, the University view remained that some students might prefer the type of engineering course that had been available within the Faculty of Arts since 1857. It was consequently continued until 1884, thereby maintaining an overlap of six years with the new professional institution, the uptown School of Practical Science. No students were enrolled in the course after the graduation of H. B. Proudfoot, in June, 1878.

3

THE SCHOOL OF TECHNOLOGY AND ITS IMMEDIATE SUCCESSOR

A DOZEN YEARS of operation of the University College course in Civil Engineering had convinced many members of the Senate that its revision or extension would be necessary if the growing technological needs of the Province were to be satisfied. Evidence of this attitude was seen in the approach made to the Provincial Government on behalf of the Senate by Vice-Chancellor Crooks and President McCaul, late in 1869, proposing the establishment of a School of Mines and Mining Engineering at the University, with a related museum. Although the Government declined to take action in the particular form that had been suggested, the soundness of the idea of Provincial educational facilities in the mining, geological, and mineralogical fields did not escape the Sandfield Macdonald administration.

Attention had been drawn to the matter by a competing enterprise in an unexpected quarter. The County of Hastings, prompted by the presence of valuable minerals within its territory, set aside a sum of money in 1869 for the payment of the salary of a Professor of Mining and Agriculture in Albert University, Belleville, Ontario. James Thomson Bell was appointed to the chair and commenced his duties in the same year. His work included lectures in the examination of minerals and metallic ores, assaying, and descriptive lectures on the extraction of minerals from the ores. This step led, in 1872, to the setting up of a Faculty of Engineering in which an ambitious two-year course in Civil Engineering was provided, on the successful completion of which the degree of Civil Engineer was to be granted. An option in mining and metallurgy was provided, leading to a diploma in Mining Engineering. In 1883 the course in Civil Engineering was lengthened to three years, but it

was short-lived. With the union of the Methodist churches of Canada the following year, the Faculty of Engineering came to an end; there were no graduates from it. Albert College then became merely a preparatory school. Prospective science students at the university level were invited to enrol at the University of Victoria College, Cobourg, where the science department offered courses in Mathematics, Physics, Chemistry, Mineralogy, Geology, and Assaying. Alternatively, they might enter the School of Practical Science, Toronto, or the Royal Military College of Canada, Kingston.

In the meantime, and paralleling University of Toronto developments subsequent to 1851, a number of other educational institutions in Canada were discussing, and in some cases setting up, courses in applied science. From the late sixties, the practical-minded Nathan F. Dupuis, Professor of Mathematics at Queen's University, Kingston, had persistently advocated the teaching of practical sciences. At the opening of the 1872–73 session at Queen's he expressed the opinion that "it is not a matter of choice with us whether we will have scientific teaching or not, but a matter of necessity. . . . if our universities will not make provision . . . schools of technology, established for the purpose, will."[1]

At King's College, New Brunswick, the initial lecture in a professional engineering course given in February, 1854, had been followed by sustained efforts to improve the attractiveness of the work to the young men of the Province. This was especially so after 1859, when the College became the University of New Brunswick, and very markedly the case after Dr. William Brydone Jack became President of the University in 1861.

President McCawley, of King's College, Nova Scotia, had from 1851 been urging his Board of Governors to make provision for instruction in sciences that might be "applied to the service of mankind." A course of lectures on Engineering Applied to Railways was given in 1867, but the organization of an engineering school did not come until 1871.

Popular lectures in Civil Engineering, given in 1855 at McGill University, had resulted in the establishment the next year of a two-year course in Civil Engineering within the Faculty of Arts. The first diploma in Civil Engineering was conferred in 1858.

[1]D. D. Calvin, *Queen's University at Kingston: The First Century of a Scottish-Canadian Foundation, 1841–1941* (Toronto, 1941).

Owing to the temporary financial embarrassment of the University, engineering instruction was discontinued in 1863, but was revived in 1871. The need for resumption and extension of this educational programme was repeatedly pressed upon public attention by Principal John William (later Sir William) Dawson. Speaking at the McGill convocation of May 1, 1871, he said:

> An urgent want now in connection with this extension of our work and influence is the institution of a School of Practical Science in connection with our University. We have long been preparing for this; and as you are aware, I have frequently, and in various ways, pressed it upon the attention of the Government and the community. Now the time appears to be particularly favourable, in consequence of the strong bias in the direction given to the public mind in every civilized country by recent events, and in consequence also of the present activity in mines, railways and other scientific enterprises in this country.

Out of this was to come the Faculty of Applied Science of McGill in 1878 and the Faculty of Engineering in 1931.

A circumstance that strongly influenced public thinking on matters of practical education, to which Principal Dawson appears to have alluded, was the disquieting technological lesson taught by the Franco-Prussian war of 1870–71. The progress and outcome of that struggle, as succeeding wars have still more strikingly shown, confirmed the principle that immense advantage accrues to the side having superior scientific and technical equipment and the knowledge of how best to use it.

Facilities for persons entering the profession of engineering were meanwhile expanding in the United States. Following those institutions that have already been mentioned, the Massachusetts Institute of Technology was established in 1865 and Stevens Institute of Technology in 1871. Many other professional schools of high standing were to arise thereafter in comparatively rapid succession.

The *Globe*, of Toronto, under the vigorous editorship of George Brown, evinced a marked interest in the subject. In an editorial appearing on November 23, 1870, it reviewed approvingly and at length the annual University Lecture delivered by Principal Dawson of McGill on the subject of "Science Education," in which he had expressed preference for endowments permitting establishment of schools of applied science in connection with existing institutions. The editorial concluded by urging that something be done at Toronto. Having learned that the Provincial Government was

"brooding over a policy," the editor called upon the Honourable John Carling, then Commissioner of Public Works, to "make a beginning in the great work of technical education."

Not until the 1870–71 session of the Legislature had been in progress for more than a month, did the Ontario Government indicate an intention of coming to grips with the problem of technological education. On January 12, 1871, a commission, signed by John Carling, was issued to J. George Hodgins, LL.D., of Toronto, Deputy Superintendent of Education for Ontario, and Alexander T. Machattie, M.D., F.C.S., of London, Ontario, to proceed to the United States "for the purpose of inspecting and reporting upon any Technical, or Science School, or College, there established, as to their buildings, departments of study and general appliances."[2]

Dr. Hodgins, who had already been in the educational service of the Province for twenty-seven years, sixteen of which were spent as the deputy of the brilliant and forceful Dr. Egerton Ryerson, was well fitted to undertake a mission of this kind. Like his chief, he was a man of inquiring mind, abounding energy, and a notable eagerness to communicate his ideas.

Dr. Machattie's qualifications for the task appear to have been based chiefly on a knowledge of chemistry and the chemical industry. There is no record of his having practised medicine in the Province. He was the proprietor of the Ontario Chemical Works, at London, where acid was manufactured until the works were destroyed by fire in October, 1869. Press items refer to his having made a chemical analysis of the water at the London Asylum and to his being an accomplished lecturer on scientific subjects.

The time available for making the inspections, studies, and reports was scant. Of necessity, the Government would have to explain and justify its plan to the House before the end of the session, and, as it turned out, the debate on the proposal occurred less than a month from the time the Commissioners were appointed. Indicative of the hurried character of the inquiry is the fact that the report was actually dated "January, 1871."[3]

The Commission was therefore forced to confine its attentions to

[2]J. George Hodgins, *Documentary History of Education in Upper Canada* (1871–72), vol. XXIII.
[3]*Ibid.*

eight institutions only: the Lawrence Scientific School of Harvard University; the Sheffield Scientific School of Yale University; the School of Mines of Columbia University; the Massachusetts Institute of Technology; the Free Institute of Industrial Science, Worcester, Mass.; the College of Chemistry, Physics, Mechanic Arts, etc., of Cornell University; the Rensselaer Polytechnic Institute; the Cooper Union of Science and Art, New York City.

Based upon its investigations and studies, the Commission suggested five broad subjects of study in the proposed School of Technology:

(1) Pure and Applied Mathematics, including therein Mathematics proper; Natural Philosophy; Civil, Military, and Mechanical Engineering; Surveying;
(2) Architecture and Drawing;
(3) Pure and Applied Chemistry;
(4) Natural Science, including Geology, Mineralogy, Zoology, and Botany;
(5) Modern Languages (French and German).

The Commissioners were of the opinion that at the outset the number of teachers should be small, each one giving instruction in all relevant branches of his particular subject. They felt that while the building to be constructed for the school should provide for work in all five of the comprehensive divisions listed, it might be found desirable to defer the instruction in the last two, that is, in Natural Science and Modern Languages. The Commissioners thought that the proposed structure should be capable of accommodating not less than 120 to 150 students. It was estimated that the cost of a main building and detached laboratories, furnishings, equipment and apparatus, chemicals, and books would not exceed $50,000.

Apparently the Commission envisaged what was then a relatively advanced type of training. It regarded the course of instruction which was outlined as making provision for "the Professional Education of Architects, Civil, Mechanical and Mining Engineers, Chemists, Metallurgists, and Teachers of Science." No recommendation was made as to the duration of the course for a diploma or a degree, but favourable reference was made to the four-year courses then in effect at the more important of the engineering colleges of the United States.

Popular evening lectures in scientific and technological subjects

after the manner of the Lowell Institute, then being founded in Boston, were commended.

Complete dissociation of the proposed institution from any and all others was deemed by the Commission as one of the chief essentials for success. It made its position clear in such passages as these:[4]

> On no point, we repeat, was the testimony of the Institutions we visited more clear, distinct and uniform than that the proposed School of Technology should, in its teaching and management and government, be kept entirely distinct from any other Institution. To attach it as an Appendage to any School or College for teaching purposes would be to ensure its ultimate failure. The more efficient the Institution to which it might be attached for these purposes (paradoxical as it may appear), the more certain and speedy would be the failure of the School. Even at the two distinguished American Universities of Harvard and Yale, where Scientific Schools exist, their efficiency and success is just in proportion to their entire practical separation for teaching and other purposes from the other parts of the University.
>
> Although, as we understand, it is the intention of the Government to erect the School of Technology in Victoria Square (on the Normal School plot), yet we would strongly recommend that it be not associated, or connected with, that Institution in any way, but left entirely under the care, management and control of the Government itself.

The hostility of the Commissioners to any idea of association of the School with another institution arose in part from the conviction that the methods of teaching ought to be very different from those followed in colleges devoted to liberal studies. In schools of technology, they affirmed, teaching needed to proceed by illustration and practice, involving to some extent the manual element. Moreover, the classes, and even individual students, required more constant teaching oversight and staff supervision. Again, a division of interest, within the teaching staff or the joint management, would inevitably prove fatal to the efficiency of one or the other.

Doubt was cast on the ultimate success of the arrangement at Cornell University, which involved a comparatively close interlocking of the work of the College of Chemistry, Physics, and Mechanic Arts with the work in liberal Arts. Whatever virtue existed in the plan appeared to arise from a more marked separation of teaching and management than the Commission expected to find.

Public interest in the Government's intentions quickly developed with the announcement of the estimates for 1871. They included an

[4] *Ibid.*

item of $50,000 for a "College of Technology or School of Industrial Science." The *Globe*, watchful and ready for controversy, remarked editorially on January 30:

> The College of Technology might commence upon a more experimental foundation. We are not informed as to where the College is to be established, nor whether it is to be independent of or connected with existing institutions; but an arrrangement for combining it with the University of Toronto would seem to afford many advantages; and an additional Professorship created for the purpose need not involve a very heavy charge in the first instance.

The matter immediately became a lively political question. Edward Blake, the vigorous leader of the Liberal Opposition, pressed for an explanation. Speaking in the Legislature on February 10,[5] the Honourable John Sandfield Macdonald, Premier and Attorney General, announced that it was proposed to erect the college on the grounds of the Normal School. Institutions of the kind under consideration had been very useful in the United States and would be so in Ontario, especially schools of mineralogy. Ignorance of that science had cost many of the inhabitants of the country dear. Engineering, metallurgy, natural philosophy, geology, botany, and other sciences would also be taught. And then, with a curious misconception of the role of a college of technology, he inquired as to whether it was not time that the drivers of locomotives, who were entrusted with so many lives, should be thoroughly taught their business!

Blake, while agreeing that increased attention should be devoted somewhere to the presentation of the subjects that had been mentioned, rejected the view that the proper way to do this was to erect separate buildings, establish a separate staff of professors, and duplicate the state of things then existing in the colleges. The subjects to be taught—Mathematics, Chemistry, Natural Philosophy, Civil and Mechanical Engineering, and the Modern Languages—could be and ought to be taught in the University. To duplicate the University within a few hundred yards of itself was a wild, extravagant scheme. In obvious allusion to Egerton Ryerson, he asserted that the proposal had come from a quarter that was always opposed to the interests of the University.

Following an interruption by the Premier to the effect (according

[5]A report of this debate appeared in both the *Globe* and the *Leader* of February 11, 1871.

to the *Globe* report), that the proposal came from Professor Chapman, the Leader of the Opposition retorted that Macdonald well knew that the scheme was supported by the Education Office; he well knew that the head of that Office (Egerton Ryerson) had opposed the University of Toronto as a godless institution and proposed that the endowment should be divided amongst the denominational colleges. That official, Blake said, wanted a rival school in the Normal School grounds under his own wing.

The Premier, obviously greatly irritated by Blake's criticism, and suffering severely from the ailment that before many months had passed was to end his career, asserted (again according to the *Globe* report) that this attempt to galvanize an institution which had failed would not be successful. He was not ready to keep up that institution by further grants of the public money—an institution which was beyond the wants of the Province. The first gentleman who was asked to prepare an estimate on the matter was Dr. Chapman and he did not know where the honourable gentleman had got his knowledge of the Reverend Dr. Ryerson's being the parent of the idea. The School was intended to be a Provincial institution. The Government had nothing to do with the University and did not wish to have anything to do with it. The difficulty the Province suffered from was that it had no college of mines where mineralogy could be studied with any degree of efficiency. This would be met by the humble institution now proposed.

The *Leader*'s version of Macdonald's reference to Chapman was that it was Chapman who "first pressed the attention of the Government to the matter." The University had failed to teach with anything like thoroughness the natural sciences that were to be taught at the School.

Since the Government evidently leaned heavily on Chapman's report, and the Honourable Edmund Burke Wood, Provincial Treasurer, had quoted substantially from it, Blake asked that the report be laid before the House. The Government refused. Diligent searches made in the governmental offices at Toronto and in the Dominion and Provincial Archives have unfortunately failed to reveal the text of this significant document. It may have been destroyed on the defeat of the Government in December, 1871, in accordance with a regrettable practice in vogue at the time whereby retiring Ministers had most of their correspondence burned so as

to avoid possible political embarrassment in later years. Be that as it may, the Chapman report, or letter, might have contained statements that would have removed all possible doubt concerning the original source of the idea to establish a School or College of Technology at Toronto.

In a series of editorials, published on February 11, 13, and 15, the *Globe* fought the proposal with ill-concealed animosity towards both the Government and Dr. Ryerson. It twitted the Premier with calling the University of Toronto an "effete" institution, not only ignoring it but insultingly and contemptuously casting it aside as one which could not by any possibility be galvanized into activity and usefulness. He should not allow it to continue effete for a single day. The worst possible way to revivify what the leader of the Government had called an "effete institution" would be to set up another institution at its very doors. It was admitted that certain necessary branches of learning as applied to arts and manufactures had not received the attention at the University which they might, and perhaps ought to, have received. The facilities there available should be utilized. A chair of Technology ought to be founded in University College and the professor appointed should, along with the professors of kindred branches, be constituted a separate Faculty of Science to grant appropriate degrees to students who might not take the Arts course at all.

At the sitting of the House on February 14, 1871, the last working day of the session, the matter came to a head. In the debate on the resolution of the Committee on Supply relating to the College of Technology, Blake, seconded by Archibald McKellar, moved:

> That no bill for the organization and regulation of the proposed College of Technology has been submitted to this House; that, besides a large expenditure in the first instance, a great annual charge will be imposed on the country for the maintenance of the said College; that buildings, appliances, and professors for instruction in almost all the branches to be taught in the College are at present provided at a great public expense in University College; that it is desirable to utilize as far as possible the existing means and therefore, before entering on the proposed expenditure, further consideration should be given to the serious question involved.[6]

In speaking to the motion Blake asserted that, although the Premier had told the House that the proposed college was mainly for the training of operating technicians and mechanics, the chief

[6]Province of Ontario, Legislative Assembly, *Journals*, 1870–71, vol. IV.

object laid down in the Hodgins-Machattie report was professional training. He was of the opinion that the conflicting objectives of the two types of training would render the plan abortive.[7]

The *Leader* of February 15 reported that the Provincial Treasurer had read to the House a letter from Professor Chapman to the effect that in order to be effective, the proposed School must be dissociated from the University.

On division, the motion was lost by a vote of 39 to 24, and the $50,000 appropriation was approved.

An interesting sidelight on the affair was afforded at a meeting of the Canadian Institute, held on February 18, 1871.[8] Dr. J. G. Hodgins outlined the proposal relating to the establishment of a School of Technology before a gathering in which Goldwin Smith, James Loudon, and Professors Chapman, Croft, Hincks, and Wilson were present. He stated that the Commission composed of himself and Dr. Alexander Machattie had found that general opinion in the United States favoured schools of technology as separate institutions.[9]

In his unpublished memoirs, James Loudon, who was later to become Professor of Mathematics and Natural Philosophy, and eventually President of the University, reported that Daniel (later Sir Daniel) Wilson, who was to precede Loudon as President, was particularly severe in his criticism of the project, and joined Chapman and Goldwin Smith in condemning the proposal to keep the School of Technology separate from the University. Wilson undertook to speak with some authority, since his brother George had in the years 1855–59 been Professor of Technology in the University of Edinburgh. Loudon himself refrained from speaking, but he observed that those who spoke for the University failed to point out the difference between the science courses in Arts and those in a technical college.

The apparent discrepancy between Dr. Chapman's condemnatory attitude with respect to the Government plan taken at the Canadian Institute meeting and the favourable one which he was reported to have expressed in the letter read by Provincial Treasurer Wood in the Legislature on February 14, 1871, may have a simple explanation. His reports, or letters, to the Government might have been

[7]*Globe*, February 15, 1871.
[8]*Ibid.*, February 20, 1871.
[9]Hodgins, *Documentary History of Education*, vol. XXIII,

with respect to a type of non-professional institution that is now known in Canada as a technical school, or perhaps a technical institute, and not a school of university grade. The understanding on the part of Premier Macdonald of the nature of the training that should be offered appeared, despite the Hodgins-Machattie report, to be more in accord with the non-professional than the professional school. Being presumably aware of Macdonald's concept, it would not have been strange if Chapman had originally concerned himself entirely with the problem of establishing suitable educational facilities for workmen and mechanics, rather than for engineers.

At the same time, Chapman was the most natural member of the existing University staff to be consulted about a professional school, being the only one of that staff with any engineering training or experience. He had studied Mining in Germany and Civil Engineering in England. For a year or two he was employed as an assistant under the celebrated civil engineer Isambard Kingdom Brunel on railway and water problems in England. In reporting on mining properties in Canada he was accustomed to style himself "Consulting Mining Engineer."

The assertion of Edward Blake in the House debate that Egerton Ryerson was the original proponent of the School of Technology plan was by no means fantastic. For a quarter of a century Ryerson had been the most active figure in general education in the Province. He had an encyclopaedic knowledge of the whole field, unbounded energy, and a consuming desire for public communication of his ideas. Moreover, he had on several occasions personally studied the rise and potentialities of technical education abroad.

It is obvious that Ryerson was favourably disposed towards the appointment of the Hodgins-Machattie Commission. Hodgins was Ryerson's deputy and presumably *persona grata* to him. Ryerson supplemented the responsible Minister's commendation of the Commission to educational heads in the United States with a personal letter of introduction. The report which followed the investigation appears to have been to Ryerson's satisfaction, whatever he may have thought of the type of institution that, by reason of a political upset, came out of it initially. This is evident from the latter's official report for 1871, in which he said:

> This latter class of Schools (Schools of Technology) are of quite recent origin in England, the United States, and, I am happy to say, in Ontario also.

> Early in 1871 the Government of Ontario sent two Commissioners [Doctors Hodgins and Machattie] to the United States to make inquiries "in regard to Schools of Practical Science." As a result of these inquiries, a Report was made to the Government, and a "College of Technology" was established in Toronto in that year. It is, I believe, quite successful.[10]

Apparently the last sentence did not express Ryerson's later view of the experiment, for in reproducing the report years later, Hodgins omitted it entirely.[11]

Ryerson, moreover, already a member of the University Senate for twenty years, could scarcely have been unaware of the scant success of the Department of Civil Engineering in University College. It was to have been expected that one so intensely active in the educational field as he was would have given thought to methods of bettering the situation. Such reflections in a man of Ryerson's type could hardly have gone unexpressed.

There were many opportunities for the conveyance of his ideas to Premier Macdonald. They were on terms of cordiality, and Ryerson had often been thanked by Macdonald, not only for the efficient management of his department, but also for assistance in situations other than those that pertained to education. In Ryerson's letter of May 18, 1870, to his daughter Sophie, he spoke of "a very friendly conversation" with Macdonald, in which the Attorney General had said that "he wished to talk with me about things in general, and proposed coming up and spending an evening with me for that purpose."[12] In the autumn, mention was made in another letter of having been "thanked by Sandfield, Carling, etc. again and again for the assistance I have given them." At Macdonald's request, he had written the paragraph in the Lieutenant-Governor's speech that referred to education, and a short time after the Premier "came up to my study . . . to read the whole draft of the speech to me for my opinion and suggestions." In such circumstances, it is inconceivable that Macdonald would not have asked for Ryerson's views on an educational matter of great importance to the Province, although it did not relate directly to the schools over which Ryerson had jurisdiction.

Direct and positive evidence of Ryerson's part in advocating the establishment of the new institution is lacking. But there is no doubt

[10]Ontario Sessional Papers, 1873, vol. V, Part 2.
[11]*Documentary History of Education*, vol. XXIII.
[12]C. B. Sissons, ed., *My Dearest Sophie: Letters from Egerton Ryerson to his Daughter* (Toronto, 1955).

that he had discussed the matter with members of the Macdonald administration at least as early as the introduction of the question in the House. This is evident from his own correspondence.

A teacher, J. Howard Hunter, writing to Ryerson on September 8, 1871, alluded to a written assurance given some months earlier by Ryerson that in the event of a School of Technology being established he would favour Hunter's appointment to a lectureship therein. In the course of his inquiry concerning the likelihood of a post being available to him, Hunter remarked that "it appears to be universally accepted that the new School of Technology will be launched into existence under the auspices of the Chief Superintendent of Education." Ryerson's reply of September 14 (preserved in the files of the Department of Education of Ontario), while negative in character, definitely admitted an earlier interest in the project. He wrote:

> In reply to yours of the 8th inst. I beg to say that I have nothing whatever to do with the projected School of Technology. I have not had any conversation or communication with any member of the Government on the subject *for months*. I wish to be relieved of my present charge, rather than to assume any new charge. . . .

In the light of the available evidence the author believes it to be highly probable that the idea of setting up a School of Technology at Toronto originated with Egerton Ryerson. If so, there was added significance in the establishment in 1948 on the old Normal School grounds of a great and useful school devoted to the promotion of the arts and manufactures through education—the Ryerson Institute of Technology.

Having obtained general approval of its plan for a School of Technology, through the appropriation of $50,000 by the Legislature in February, 1871, the Government issued in March a circular addressed to the "Manufacturers of Ontario," stating that the object of the proposed "School of Industrial Science" was

> To provide, in a two-fold form, for the education of Mining and Civil and Mechanical Engineers; of Manipulation in Metals; of Workers in Wood, Leather, Woolen and Flax Fibres; of Designers, Modellers and Carvers in the Decorative and Industrial Arts; and of persons desirous of studying Chemistry, as applied to our various Manufactures.

They were asked to reply to a series of questions and to state their views as to the actual requirements of the profession or business in

which the person or organization replying was engaged. To this circular replies were received from eighty-nine persons engaged in engineering, manufacturing, or related fields.[13]

The summer of 1871 passed without a decision by the Provincial Government respecting physical accommodation for the School of Technology. It had gradually abandoned the idea of erecting a building on the Normal School grounds and was reported as "hunting around" for an existing one in which to locate the new institution. On September 5, the *Globe* alluded scornfully to the proposed sale by the Mechanics' Institute of its building at the corner of Church and Adelaide Streets to the Province and observed that the school "ought to be in connection with the University, instead of being made a hostile establishment."

Nevertheless, by Order in Council dated September 8, 1871, the Government concurred in the recommendation of the Commissioner of Public Works that the offer of the Mechanics' Institute building be accepted. It provided for the transfer to the Province of the Institute building and certain adjoining property for the sum of $36,500.

During the next three months recurrent double-pronged verbal assaults were launched by the *Globe* against the directors and members of the Mechanics' Institute for entertaining the idea of sale, and against the Macdonald Government for embarking upon an ill-considered educational venture.

The Government, said the *Globe* on September 8, 1871, refusing to make a modest beginning in conjunction with the University, had voted a sum far less than the cost of constructing and equipping a suitable new building, and so might well feel that erecting a new college was an absurdity. Except for the happy chance of buying the Mechanics' Institute building they would be as far off as ever.

Again, in the view of George Brown (expressed in the *Globe*, September 9, 1871), creating a technological institution apart from the University would mean two groups of professors teaching exactly the same things, where one could do better and more economically. If the single-institution plan were not followed, we should have our technical education subsiding into superficial and comparatively useless sham, a sort of Mechanics' Institute in which young apprentices or trades lads might have a pleasant way of spending an

[13]Hodgins, *Documentary History of Education*, vol. XXIII.

evening now and then in a semi-scientific way, when nothing more exciting was on the carpet. It would be stimulating for technology students of university grade to be in contact with large numbers of students engaged in various non-technical departments of study.

McGill University, on appointing a Professor of Civil Engineering and a Lecturer in Assaying and Mining to the Department of Applied Science within its Faculty of Arts, was commended by the *Globe* on September 14 for doing "what our authorities in Ontario ought to do." To the editor it was a sensible and praiseworthy act, compared with "the foolish and ill-considered technological affair in Ontario, which, planned and proposed by perverse and disappointed self-conceit [an apparent reference to Ryerson], had been first adopted by our Government and afterwards endorsed by Parliament, to be the means of spending the peoples' money, and afterwards to be abandoned as a palpable mistake."

Following a special meeting of the Mechanics' Institute to consider a protest against the sale of its property to the Government, the *Globe* announced on September 25 that the sale could be stopped only by legal action. This was not taken, and the transfer became effective.

Despite the relentless campaign of the *Globe* in opposition to the setting up of the School of Technology, the Government proceeded with the plans. A contract for necessary alterations in the Mechanics' Institute building was let early in November. The *Globe* deprecated this, in that with a change of government the whole project might have to be changed. It returned to the charge that no plan of operations had been outlined, or even agreed upon. What was to be the number of instructors or their departments? It was hinted that some professors might be brought down from University College to redeliver lectures already made use of on the same day in their regular classes.[14]

Prior to the Order in Council of September 8 accepting the offer of the Mechanics' Institute building, much confusion existed concerning the name of the proposed institution. This arose largely because no bill had been brought before the House defining its nature and government. Action had been taken solely on the basis of an item of $50,000 in the estimates for an indefinitely described "College of Technology or School of Industrial Science." But the

[14]*Globe*, November 13, 1871.

Order in Council specified that the property was for the purposes of the proposed "Technological School," although Carling in his recommendation had termed it a "Technological College." Members of the Legislature had used both designations indiscriminately. The name was finally fixed by the use of the term "School of Technology" in the official announcement of the opening classes signed by the Commissioner of Public Works in the succeeding Blake administration.

In his speech at the opening of the Legislature on December 7, the Lieutenant-Governor stated that the new School of Technology would be opened shortly for preparatory education of skilled men as engineers, managers, and operators in the various mechanical and manufacturing establishments and in the steamboat and railway systems of the country. The *Globe*, in derision, remarked that "the Technological School in the Mechanics' Institute is paraded once more." But even Blake was tiring of the controversy, for in the debate on the address he questioned "whether it was wise to discuss the Technological College that had been established . . . whether they should take the roof off the Technological College."

But the matter was soon to fall into the lap of a Government headed by Blake himself. On a 44 to 25 vote of lack of confidence taken on December 18, the Government was defeated. Next day, Premier Macdonald announced in the House the resignation of the Government and the Lieutenant-Governor invited Blake to form a ministry.

The new Provincial Treasurer, the Honourable Alexander Mackenzie, in making the annual financial statement on February 7, 1872, called attention to the School of Technology and the need of taking a vote for it, without having had the time to mature a plan for its management. The old Government, he said, had undertaken this "without any regular plan, or apparently without any idea of what its cost or maintenance would be." He thought that this institution and the Agricultural College would have been placed on a better footing had time been taken for deliberation, and thoroughly completed plans been prepared. However, he asked for approximately $11,500, which represented the difference between the $50,000 vote of 1871 and the amount already spent on the project. Although in the Committee on Supply on February 15, Mackenzie stated that an explanation as to the intentions of the Government

respecting the School of Technology would be given in the House on the vote for maintenance, none was given before the session ended on March 2.

By reason of the long delay in maturing an operating plan it was mid-April before any public announcement was made. This took the form of an invitation to applicants desiring positions as instructors in the new School.[15] It was required that they be qualified to give instruction in (1) Practical Geology, Mining, Chemistry; (2) Engineering and Architectural Drawing; (3) Applied Mechanics and Mechanical Drawing. Commencement of classes was set tentatively for May first.

The degree of response to the advertisements is not known, but in May, 1872, three of the applicants were appointed to the staff. William Hodgson Ellis, M.A., M.B., became Instructor in Chemistry, and, without formal title, undertook to act as Principal of the School; William Armstrong assumed responsibility for Mechanical and Architectural Drawing; Thomas H. Heys was selected as the Assistant in Chemistry, and later in Natural Philosophy as well.

Dr. Ellis—artist, poet, and incomparable teller of Indian tales—was then a young man of twenty-seven. He had obtained his Bachelor's degree in Arts at Toronto in 1867 and his Master's the following year. In 1870 he became a M.B. of the Toronto School of Medicine. After "walking the hospitals" in England, he returned to Toronto in 1871 and practised for a few months.

It happened that at that time an occupant of the vacant chair of Natural History in University College was being sought. Ellis applied. Professor William Hincks, who had just retired from the post, knew him well as a student and recommended him as one who would discharge the duties of the Natural History professorship with distinction. Professor Daniel Wilson spoke highly of him. However, the appointment went to another.

But there were plenty of things for Ellis to do. In 1871 he was appointed Lecturer in Chemistry in Trinity Medical School and two years later became part-time Professor of Chemistry in that institution. In another year his duties were enlarged by a lectureship in Physical Science in Trinity College to students in Divinity and Arts.

The part-time appointment to the staff of the School of Technology was to be followed by steadily increasing responsibilities in

[15] *Ibid.*, April 13, 17, 20, 1872.

many directions. In 1914 he became the second Dean of the Faculty of Applied Science and Engineering of the University of Toronto, after a long service as Professor of Applied Chemistry.

William Armstrong, upon graduating in Civil Engineering from Dublin, and working on several English railways, had come to Canada in 1851. Shortly after his arrival he became an applicant for the professorship of Civil Engineering in University College, a position that was never filled. In this country he was employed on the Grand Trunk and the Northern Railway, but gradually abandoned engineering for a career in art. From 1864 to 1884 he occupied the position of Drawing Master at the Toronto Normal School. He was to serve as one of the staff of the School of Technology and its successor, the downtown School of Practical Science, from 1872 to 1877.

Thomas Heys was later to found an important practice as a consulting chemist and analyst in Toronto.

More definite information respecting the opening of classes was contained in another advertisement, first appearing on April 22 (it ran in the *Globe* until May 3, 1872), the complete text of which was as follows:

[*Arms of the Province*]

SCHOOL OF TECHNOLOGY

EVENING CLASSES

will be opened in this school on

MONDAY, THE 6th DAY OF MAY NEXT

For the special instruction of mechanics and others in the following subjects:

1. Drawing
2. Natural Philosophy
3. Chemistry

Hours of instruction from a quarter to eight o'clock till a quarter to nine o'clock each week day evening, excepting Saturdays.

Admission to classes to be by ticket, which may be obtained free of charge, from W. H. Ellis, M.B., at the School, corner of Church and Adelaide Streets at 8 o'clock p.m., on Monday, Wednesday, and Friday of each week, until the opening of the School.

A. McKELLAR,
Commissioner of Public Works

Toronto, April 19, 1872.

The classes that began on May 6, 1872, were held in an historic building. Erected in 1854, at the northeast corner of Church and Adelaide Streets, to serve the purposes of the Mechanics' Institute, it housed the School of Technology and its immediate successor for five years. It was then resold to the Institute. In 1883 the Free Library Board took it over. From 1884 to 1927 it was occupied by the Toronto Public Library, while for the twenty-two years preceding its demolition in 1949 it was put to a variety of non-educational uses.

From the first two reports submitted to the Government by Dr. W. H. Ellis, who acted as Principal, one may gain a clear impression of the operations of the School for its initial calendar year.[16] Illuminating is this item in his First Report:

> The classes, it will be remembered, were without fees, and as the idea of evening classes on scientific subjects for mechanics and others had the charm of novelty, many came, as it was to be expected, out of mere curiosity, or to pass away an idle hour. These, after the novelty had worn off, and when they began to find that the classes required regular application and conscientious study, naturally ceased to attend, while those who came not from idle curiosity, but from an honest desire for improvement, and a determination to avail themselves of every opportunity of acquiring useful knowledge and mental training, continued to pursue their studies until the close of the term.

Of the 181 who enrolled in the new institution, most were mechanics, whose attendance would not have been possible in daytime. The drawing classes proved to be particularly popular and special temporary accommodation had to be obtained in the adjacent Music Hall. Finally, after many who dropped out had been replaced by more eager students who had been refused admission because of insufficient accommodation, the number in the class stabilized at 98. Chemistry, which offered the attractive feature of some practical work, drew 91, and Natural Philosophy, 50.

Instruction, which was given each week evening except Saturday, was discontinued for the summer holiday at the end of July and resumed on September 16. Towards the end of December, 1872, fifteen students presented themselves at an examination in Chemistry, and passed.

In October, 1872, after the autumn term of the School of Technology had been in progress for several weeks, James Loudon, then

[16] W. H. Ellis, First Report, O.S.P., 1873, vol. V, Part 2, no. 8; Second Report, O.S.P., 1874, vol. VI, Part 3, no. 12.

Mathematical Tutor and Dean of Residence in University College, was asked by the Honourable Adam Crooks, Provincial Treasurer, to become Lecturer in Natural Philosophy in the new institution. He declined. In his unpublished memoirs, Loudon states that a day or two afterwards he was visited by Professor Daniel Wilson, who asked the reason for the refusal. When he told Wilson that he did not care to serve on the staff as Crooks had constituted it, Wilson gave his assurance that the settlement of the matter rested with him and not with Crooks. The arrangements already made were temporary. On this understanding, Loudon agreed, and his course of free lectures on Natural Philosophy began on November 15. At first these were devoted entirely to Mechanics, but subsequently, when the necessary apparatus was provided, the subject of Light was added.

By the end of 1872 the Government had come to the conclusion that the status and operating policy of the School ought to be clarified by legislative action. As a result, the Lieutenant-Governor, in opening the House on January 8, forecast "a Bill Regulating the Technological College, for which the Legislature has already made provision."

Much thought had been given to the matter before this announcement was made and most of it by Adam Crooks. An able and energetic member of the legal profession, he had long been interested in educational matters. He was an 1850 graduate in Arts, a B.C.L., and had served as an examiner in the Faculty of Law. Since 1859 he had been an active member of the Senate of the University of Toronto and had just completed a service of seven years as Vice-Chancellor. Elected in 1871 as a Liberal member of the Legislative Assembly, he had been Attorney General under Blake and was now Provincial Treasurer under Mowat. For many years, seven of which were spent as Minister of Education, he was to give enlightened and constructive effort to the provision of proper facilities for professional engineering education in Ontario.

On January 21, 1873, Crooks introduced a measure entitled "An Act to Establish a School of Practical Science" and it was given a first reading. In the debate on the Bill, the Minister said, on March 18, that the Government was disposed to carry out the existing arrangements that had been made for the School of Technology until they could work out a scheme of a permanent character. The

building in use was inconveniently situated and its internal arrangements were unsuitable. It could be sold for a sum sufficient to erect a new and in all respects convenient building on the University grounds, by which means they would be able to avail themselves of the lectures and numerous valuable appliances at the command of the University. Despite objections of the Opposition, principally on the ground of cost to the Province when a very large proportion of the students resided in Toronto, the Bill was approved on division.

The need of educational facilities for French-speaking Canadians desiring to become engineers was meantime becoming apparent in Quebec. It was not, however, until 1873 that definite action came. In that year there was founded at Montreal the Ecole des Sciences Appliquées aux Arts et à l'Industrie. Two years later the name was changed to the present one, Ecole Polytechnique.

The "Act to Establish a School of Practical Science" (36 Vict., c. 30), assented to on March 29, 1873, declared that the School was instituted in the Province of Ontario for instruction in mining, engineering, and the mechanical and manufacturing arts. In connection with it there was to be a museum of geology and mineralogy, with other branches, in order to afford aids for practical instruction and illustrations of the mineral and economic products of the Province. The School might be continued in the building already acquired, or such building might be sold and new premises erected or obtained.

Provision was made for the acceptance of gifts, and owners of mines in the Province were, on request, to furnish specimens of ores or minerals or be subject to fine. The School was to be provided with all appliances and apparatus necessary for practical education within its scope and the course of instruction was to be with reference to certain groups of subjects specified in the Act. Four of these groups were in the technological field, while the fifth was defined as "such further subjects as will promote a knowledge of the physical sciences."

Authority was given for the making of such rules as the Lieutenant-Governor in Council might prescribe for the government and management of the School. He might also entrust the internal management and discipline to a Board or Council, composed of the lecturers and instructors.

Besides training students in regular classes, instruction was also to be given to artisans, mechanics, and workmen, in evening classes,

in such subjects as might further their improvement in their different callings.

The Lieutenant-Governor in Council might make arrangements with University College for students of the School to attend such lectures at the College as came within the prescribed course or subject of instruction; he might reach an agreement with the University of Toronto for the use of its library and museum, and for the acquisition of geological and mineralogical specimens; and he might also affiliate the School with the University, but only to the extent of enabling students of the School to obtain, at the examinations of the University, rewards, honours, standing, scholarships, and degrees in Science.

In his memoirs, James Loudon recounts a circumstance that he believed to have influenced the choice of the designation "School of Practical Science" for the institution that had its birth under the name of the School of Technology, or whatever people in the prevalent confusion cared to call it. Loudon had been in correspondence with Professor Robert Stawell (later Sir Robert) Ball, of the Royal College of Science, Dublin, with regard to certain apparatus for illustrating mechanical principles and had received from Ball a copy of the syllabus of the Dublin institution. Since one of its activities was a course of evening lectures similar to those being given at Toronto, Loudon sent the syllabus to Adam Crooks for his information. At that time Crooks was preparing the Bill covering the reorganization of the School of Technology and, if he required it, he might find a precedent in the name of an important contemporary institution for the use of the word "Science." In adopting a designation, Crooks took care, however, to indicate the practical character of the School for which he bore governmental responsibility.

It is more probable that the suggestion of the name that was actually adopted came from another source. Principal Dawson, at the McGill University convocation of May 1, 1871, had spoken of the need of instituting a "School of Practical Science" in connection with McGill. Crooks, long vitally interested in such matters, no doubt saw a report of this address, which was published in the *Globe* and probably in several other newspapers.

Loudon did not like the designation that was selected. The *Globe* of January 17, 1874, reported that he thought the use of the term "Practical" was most unfortunate, in that inferentially the teaching

of science in University College was made to appear other than practical. If there was to be any further legislation, the old name (School of Technology) ought to be restored, or the adopted one changed by substitution of the more appropriate term "Applied" for "Practical."

Throughout the calendar year 1873, the School of Practical Science, as it was known after the passage of the Act relating to it on March 20, continued in the role of an evening school for artisans, although the legislation cleared the way for its transformation into a professional school. The total enrolment was 129. Of these, 88 were admitted to the Drawing class, 54 to Chemistry, and about 50 to Natural Philosophy. Contrary to the experience of 1872, the attendance continued to be good from beginning to end. "This," Dr. Ellis observed, "is evidence that the working classes are fully awake to the advantage to be gained from the study of Practical Science."[17] Voluntary examination were taken by the more ambitious students and subject certificates granted.

In order to take advantage of the section of the School of Practical Science Act providing that specimens of ores, minerals, and mining products were to be furnished by mine owners on request, Dr. Ellis visited most of the mines along the north shore of Lake Superior in August, 1873. He was successful in acquiring a large number of valuable specimens for the School. His assistant, Thomas Heys, supplemented the collection by a visit to mines in eastern Ontario and Quebec.

In the light of what was to come of the educational venture represented by the downtown School of Practical Science it is of interest to note that in 1873 James Loudon ordered for the School from Dublin a very complete set of apparatus for the teaching of experimental mechanics. Referring to it, Dr. Ellis remarked that "it is specially adapted for the instruction of those employed in workshops and will be peculiarly appropriate for the teaching of the important branch of Applied Mechanics in connection with the contemplated department of engineering."[18] There is no doubt that Ellis regarded the Act of 1873 as a charter for the coming professional school of engineering.

It is evident that in preparing the legislation creating the School

[17]Ellis, First Report.
[18]*Ibid.*

of Practical Science, Adam Crooks had given much thought to the essentials for success of the new institution, which he envisaged as a professional school. His views were set out at some length in a report to the Cabinet Council made under date of June 16, 1873.[19]

In that historic report he described the use and defects of the space in the building that had been purchased by the former Government for the School of Technology. The internal deficiencies were so great that he did not think that the School could be successfully carried on against them, or at least flourish as might be reasonably expected; and its distance from University College would preclude the advantages to which he had referred in previous memoranda. Since the *raison d'être* of the School was practical instruction, as distinguished from theoretical instruction, which could be obtained through the lectures in University College on cognate subjects in science and physics, it would be a mistake to attempt its establishment in the Mechanics' Institute building. The unsuitable location and imperfect equipment would not only result in present failure, but operate prejudicially on the School when established under proper and satisfactory conditions. He therefore recommended that a suitable building be secured as soon as proper arrangements could be made.

A proper curriculum for the School, Crooks thought, should be such as would supply instruction of a practical character in science applicable to the industrial arts, such as mining, engineering, and the manufactures. The subjects of instruction should include

(1) Applied Chemistry, with Geology, Mineralogy, and Metallurgy;
(2) Applied Mathematics in connection with mechanism and machinery;
(3) Mechanical Drawing, Engineering, and Surveying.

The course should extend over three years at least, including the summer months, for instruction in the field, mine, and manufactory.

Crooks observed that it was desirable to obtain as much knowledge as possible of the best means for making the School of the greatest usefulness and announced that he would shortly have the opportunity of examining the facilities and operation of the Royal College of Science in Dublin and institutions of this type in London.

He recommended that the property then in use at Church and Adelaide Streets be offered for sale and that the School be established

[19]Attached to Order in Council of June 23, 1873.

as soon as possible in a building specially adapted to its work to be erected on a suitable site in the proximity of University College.

Under date of June 23, 1873, an Order in Council was issued concurring in the report of Crooks and advising that it be acted upon. Thus was fixed the broad policy of creating at Toronto an engineering school of professional status under independent control, but having an advantageous association with the University.

In July, 1873, Crooks examined the workshops of the Royal College of Science, at Dublin, as well as the Schools of Science and Art at Kensington and the Museums of Practical Geology in London. He was confirmed in his opinion that in technical schools such as he saw, there is generally a tendency towards subjects of general instruction and that the establishment and maintenance of any school of this nature entails a large expenditure. He accordingly considered it desirable not to proceed at once with the project of erecting a new building, but to continue the School of Practical Science in its then temporary state until a definite conclusion on the matter could be reached.

Meanwhile, James Loudon, who had been elected to the Senate of the University by Convocation on May 21, 1873, was displaying a lively interest in educational policy as it affected a professional school of engineering. He drew the attention of the Senate to the marked difference between the science of an Arts course and that of an Applied Science course, contrasting, for example, the Theoretical Mechanics of the former with the Applied Mechanics of the latter.[20]

In the course of a newspaper controversy on "University Reform," Loudon wrote a long letter, published in the *Globe* of January 17, 1874, under the caption "The College of Technology," in which he advanced many sound ideas concerning an engineering school. The function of the School of Practical Science, said he, should be to give a purely professional training in certain branches and not to supplement the scientific teaching of University College. Instruction should be chiefly in the various departments of Engineering—Civil, Mechanical, and Mining. The Applied Mechanics entering into the studies of these departments never formed a part of the Arts course, but was entirely distinct from that branch of Natural Philosophy called "Mechanics." It is an application of the

[20]James Loudon, unpublished memoirs.

principles of mechanics to the various problems likely to be met in engineering. Drawing, said Loudon, is important in an engineering school. Applied Chemistry is chemistry applied to arts and manufactures. The essential branches to be taught are totally distinct from any that form part of a course in the Faculty of Arts, or in University College, or are intended under any of the schemes proposed to reform the science teaching in that institution. There would be no duplication of teachers so far as these applied science subjects were concerned. While languages could be taught to students of the professional school by University College professors, there were strong reasons why such auxiliary subjects as Mathematics, Natural Philosophy, Chemistry, Mineralogy, and Geology should not be taught by University College. An adequate treatment could be given by applied science professors.

The real advantage to the country in establishing a union between the professional school and University College would, in Loudon's opinion, be in the saving to be derived from a common library and a geological museum. The new school should be placed under distinct and independent direction. A professional faculty should not be subordinate to, or form a part of, a non-professional one.

For the Government, the year 1874 was a year of uncertainty and indecision so far as a definite plan of development for the School of Practical Science was concerned. The activities of the School were consequently confined to giving instruction to artisans, mechanics, and workmen, in evening classes.

The numbers applying for admission continued to be large for the available accommodation. In the autumn of 1874 enrolment rose to 189. The number of students seeking admission to the class in Architectural and Mechanical Drawing was far greater than it was possible to accommodate. Progress in the subject, under William Armstrong, was most gratifying and the work done by many of the students was of a highly creditable character. Speaking of the School, and in particular of the work in Drawing, a correspondent, David Edwards, had written in the *Globe* of February 20, 1874:

> Here I found several well-appointed rooms, in some of which were about forty pupils, engaged in freehand or mechanical drawing. They have the advantage of the oversight of an accomplished artist, whose pleasure coincides with his vocation to instruct.

Fully illustrated lectures on Light, given by James Loudon, proved

to be very popular and were attended not only by regular students of the School but also by many others. Apparatus of excellent quality had been procured from London by him for the School, which, while not elaborate, proved to be effective for the purpose.

A little more than three years from the inception of operations in 1872, Dr. Ellis, reporting on the work of the School for the period January, 1874, to June, 1875, announced with regret that Loudon had resigned his position, on being appointed to the chair of Mathematics and Natural Philosophy in University College.[21] Despite the expressed hope of Ellis that Loudon would continue his lectures for at least the coming winter, this proved to be impracticable. Thereafter no further instruction in Natural Philosophy was offered in the downtown School of Practical Science.

Indicative of the feeling of the staff of the School with respect to the general direction that its development should take is a paragraph from Ellis's Third Report, written in the summer of 1875:

> At the present day no country can afford to omit furnishing the best means of scientific training at her command to those willing to avail themselves of it, and least of all a country whose wealth must so largely depend upon her mineral resources as our own. At the same time, however, all facilities supplied by Government for such scientific training should be the natural outcome of a need felt, and any premature attempt at forcing an elaborate scheme of scientific education on a people unprepared for it could only result in failure. It would seem, however, that the time had now arrived when circumstances would justify, and indeed command, the adoption of some more extended and more permanent scheme. Letters are constantly being received at the School from all parts of the country, asking if the regular course has yet been instituted, and expressing a desire on the part of the writers to become students of such an institution as is proposed.

Not long after James Loudon's appointment as Professor of Mathematics and Natural Philosophy in University College, Vice-Chancellor Thomas Moss inquired, on behalf of Provincial Treasurer Adam Crooks, whether he would undertake to report on a policy of development for the School of Practical Science. Loudon consented, and reported his views and recommendations under date of December 17, 1875. The report was annexed to a Supplementary Report of Dr. Ellis, of the same date, covering the work of the School for the autumn term and was declared to be "by way of addition to the reports of Dr. Ellis and Mr. Armstrong."[22] No doubt

[21]W. H. Ellis, Third Report, O.S.P., 1875–76, vol. VIII, Part 3, no. 27.
[22]W. H. Ellis, Supplementary Report, O.S.P., 1875–76, vol. VIII, Part 3, no. 27.

the selection of Loudon to undertake the study was a consequence not only of proven ability, but also of his activity in public discussion of the subject and his experience as a lecturer in the downtown School.

At the outset, Loudon undertook in his report to correct a common impression that the institution then operating had been all along in a position to provide the training of a regular College of Engineering, or School of Science, and to afford at the same time the educational advantages of a thoroughly equipped Mechanics' Institute. Actually, the existing arrangements were merely temporary and in no way intended to carry out the very comprehensive aims foreshadowed in the School of Practical Science Act. While the experiment that had been tried could not be pronounced unsuccessful, no pretence had been made of providing instruction in engineering, or of carrying out any general scheme of evening classes for artisans. The part played in the larger scheme by such instruction as had been given in the School was comparatively small.

To meet the educational requirements of the country at large the Act required, in effect, that emphasis be placed upon (1) instruction in the various branches of Engineering and Chemistry as applied to the arts and manufactures, and (2) encouragement of a more practical study of the Physical Sciences.

Under the first heading, said Professor Loudon, came the wide subject of Engineering, embracing the subdivisions of Civil, Mechanical, and Mining Engineering. With regard to these, and all other professional subjects, he held that where the demand was sufficiently large for such training, it was best to provide a separate School, independent of the control of an Arts Faculty. He reiterated the belief expressed in his letter of January 17, 1874, to the *Globe* that for an institution of this kind there should be at least five professors, who could give instruction in such subjects as Drawing, Mathematics, Applied Mechanics, Surveying, Assaying, Metallurgy, Civil Engineering, etc. He did not undertake to discuss the need of an independent School, but warned the Government that the financial burden of support, which would involve a large immediate outlay and a maintenance cost of at least $15,000 a year, ought not to be assumed unless the demand for trained engineers was very great indeed.

The expenditure mentioned would be incurred solely for the

teaching of Engineering and Applied Chemistry, while additional provision would have to be made for what Loudon considered to be the still more important object—the promotion of the practical study of the Physical Sciences. Such provision ought to be made in connection with the University of Toronto, when, by a moderate outlay for necessary additions, the country could be placed in possession of a good physical laboratory in which students could receive that practical instruction which makes the teaching of sciences really effective.

Professor Loudon then proceeded to offer suggestions with regard to the best means of compassing the declared objects, taking into account the circumstances of the country.

For the teaching of Engineering, it would be amply sufficient, in his opinion, to establish a chair of Civil Engineering in University College, where a competent professor could give all the necessary instruction (as was done elsewhere under like circumstances) in Drawing, Surveying, Applied Mechanics, and Civil and Mechanical Engineering. He made no comment on the fact that a professorship had been established in 1851 but never filled. Training in the subjects pertaining to Mining Engineering, such as Assaying, Metallurgy, etc., could, he thought, be given by Professor Chapman, who would require for the purpose a small laboratory and the aid of an assistant.

To meet the considerable demand that existed in the country for practical laboratory instruction in Qualitative and Quantitative Analysis, it would be necessary to provide more accommodation and teaching power than University College could at the moment afford. The necessities of the case could be fully met by appointing a skilled assistant to Professor Croft and furnishing additional accommodation and apparatus.

While the cost of equipment for Engineering and Chemistry would be small, he found that a considerable outlay would be required to provide physical apparatus for the experimental illustration of the subjects of Mechanics, Sound, Heat, Light, etc. No accommodation existed in University College for instruments, but it could be supplied in an adjacent new building of moderate dimensions which, at the same time, would afford space for Qualitative Analysis, Assaying, Physiology, and a lecture room. This building, with the new apparatus and the appliances already in the possession

of University College, would constitute a tolerably good physical laboratory.

Loudon estimated that the building, which he termed an addition to the University building, would cost $20,000. New apparatus would require an expenditure of $14,000 and annual maintenance would be $5,200. The latter included the salaries of a Professor of Engineering, an Assistant Professor of Chemistry, and an assistant in the assay laboratory.

He was of the opinion that the Mechanics' Institute was the proper place to provide facilities for the artisan classes to improve themselves. Such offerings formed no necessary adjunct to a School of Science, although they might be carried on in connection therewith. Lectures in popular science for the general public might best be left to the Canadian Institute.

The report was well received. In his memoirs, Loudon remarks that soon after it was submitted to the Government, Vice-Chancellor Moss informed him that his "stock had gone up there," and that when Provincial Treasurer Crooks had shown the report to Colonel Gzowski, the latter had enthusiastically commended it. There is no doubt that it outlined a simple and relatively inexpensive plan for extending the activities of the School of Practical Science into the field of professional education.

Action on the Loudon report was delayed for more than a year. In February, 1876, Adam Crooks became the first Minister of Education for Ontario and was so much engrossed in the duties of his new office that the matter was allowed to rest until he could give it the attention that its importance demanded.

With the withdrawal of James Loudon from the staff of the School, a revision of curriculum became necessary. Natural Philosophy was no longer taught, and for the autumn term of the session 1875–76 the work was confined to Chemistry and Drawing. Instruction of the more advanced students in Chemical Manipulation and Qualitative Analysis was given by Dr. Ellis, for which a fee of ten dollars per student was charged to cover the cost of chemicals and apparatus. In the spring term of 1876 Dr. Ellis also gave a course of lectures in Geology. The total enrolment for 1875–76 was 157 students.[23]

The last session of the downtown School of Practical Science,

[23]W. H. Ellis, Fourth Report, O.S.P., 1877, vol. IX, Part 3, no. 13.

namely 1876–77, commenced with an enrolment of 147. Instruction was confined to Chemistry and Drawing, with an added class in Botany conducted by Dr. Ellis. Work continued until April, 1877, when all the apparatus, books, and other property of the School were removed to the old King's College Building in Queen's Park, and there stored until such time as a new building on the University campus might be ready for their reception.[24]

In the meantime, the School was not without public attention, some of it hostile. On January 19, 1877, William Ralph (later Sir William) Meredith, a future Chancellor of the University of Toronto, opposed the vote to the School of Practical Science in the House, on the ground that it was a purely local institution. At the suggestion of Adam Crooks, the interested Minister, the item was allowed to stand over. A wider consideration of the fortunes of the School was in the immediate offing.

On January 30, 1877, Adam Crooks placed before the Cabinet Council his long-considered conclusions and recommendations with respect to the reorganization of the School of Practical Science. They revealed the strong influence of the Loudon report of 1875 on his thinking. In general, he regarded the objects to be sought in the establishment of the new institution as: (1) the encouragement of more practical study of the physical sciences; (2) professional training for such as desired to become engineers (civil, mining, or mechanical) after a regular course of instruction; (3) the improvement of the knowledge of artisans by means of evening classes; (4) the diffusion of physical and scientific information through popular lectures.

After quoting liberally from the Loudon report, the Minister declared that he was satisfied that there was insufficient demand in Ontario for a distinct and separate professional school for the training of engineers to justify the attendant expenditure on capital and maintenance accounts. He agreed that the study of the Physical Sciences would be promoted by the proposed plan of utilizing the services of the University College Professors of Chemistry, Natural Philosophy, Geology and Mineralogy, and Natural History and Botany. These could be obtained without additional expense, and it would be necessary to pay only for a skilled assistant to the Professor of Chemistry, and an attendant for the Professor of Miner-

[24]W. H. Ellis, Fifth Report, O.S.P., 1879, vol. XI, Part 6, no. 67.

alogy. Apparently Mathematics was included in Natural Philosophy, since responsibility for the subject rested with the Professor of Mathematics and Natural Philosophy.

The Minister's concept of the basic importance of the subjects to be given by the Professors in University College is apparent from the following excerpt from the memorandum:

> The subjects taught by the Professors of these four Departments include so much of the range of Physical Science, that, with the proper apparatus, a physical laboratory and appliances, the means of obtaining a complete theoretical and practical training would be secured for those pursuits in which physical science is the groundwork, and with the addition of an Instructor in Engineering, the original objects of the School would be preserved, and carried into full effect. The training which would be thus afforded is intended to be available both to the University student pursuing his regular course, and to all others who may desire instruction in these special branches of knowledge.

An allusion is made in the last sentence to the advantages that might accrue to students registered in the existing Civil Engineering course in University College and electing to remain therein until graduation.

The Directors of the Mechanics' Institute having offered to repurchase their former property for the sum of $28,000, the Minister recommended that the Lieutenant-Governor in Council, with the approval of the Legislative Assembly, sanction its sale for the sum mentioned. He recommended further that out of the proceeds the sum of $20,000 (the amount mentioned in Loudon's report) be applied "in building a Physical Laboratory near the University; that the residue of $8,000 be applied for the purchase of the necessary apparatus; and that the annual appropriation of the Legislature for the maintenance of the School of Practical Science (not exceeding $5600) be applied towards the salaries of the proposed Instructor in Engineering, the Assistant in Chemistry, the attendant in Mineralogy, and for incidental expenses."[25]

Action on the Crooks memorandum was soon taken. On February 1, 1877, a Committee of the Cabinet Council advised that the recommendations made therein be approved by the Lieutenant-Governor. This was done on February 3. Full presentation of the proposals was given in the House by Crooks on February 8, when

[25]Province of Ontario, Legislative Assembly, *Journals and Appendix*, 1877, vol X.

moving that the matter be considered in Committee of the Whole next day.

A lengthy debate followed on February 13 in the Committee of the Whole. The Opposition was hostile. Mr. McDougall, of Simcoe, did not think that the young men who went to the University would avail themselves of the new School any more than ordinary students had availed themselves of the existing institution. If the special purpose for which the new building was intended should fail, the structure could be adapted to no other purpose. Observing that few, if any, University students followed Engineering, Mr. Merrick asserted that it would cost several thousand dollars to educate each entrant to the new institution. The reorganized School of Practical Science should be located in the Mechanics' Institute premises, if it was found necessary or advantageous to a country to have such a school. However, if found impracticable, as he was convinced it would be, that particular building could be sold. Mr. Lauder regarded the proposed annual expenditure of $5,600 as, in effect, an increase in the cost of operating University College, an institution that had failed to attract the young men of the country as it should do. He did not think that Arts students would attend the lectures of the single Engineering professor whom it was proposed to engage. Premier Mowat took Mr. Lauder to task for denouncing University College, as if the Government were giving it further assistance. The very opposite was the case. The School of Practical Science was being moved so as to take advantage of the facilities of University College. It was the intention of the present Government to carry out the plan of the preceding administration, that is to provide for the higher training of students, but on a more economical basis.[26] Criticism having run its course for the moment, the Committee reported without amendment the resolution approving the Order of the Lieutenant-Governor in Council dated February 3 relating to the School.

But the matter was not yet concluded. When the House was considering resolutions from the Committee on Supply, on February 21, it was moved by Mr. Patterson, of Essex,

> That as the Reports brought down to this House have shewn that the pupils attending the School of Practical Science were principally residents of the City of Toronto and the Village of Yorkville, and that the advantages,

[26] *Globe*, February 14, 1877.

if any, are purely of a local character, and as it is proposed to sell the property now owned by the Province and used for the purpose of the said School of Technology, and which cost $35,000 in the year 1871, to the Mechanics' Institute of the City of Toronto, for the sum of $28,000, and incurring a loss to the Province of $7000 on the said sale, and devoting a large portion of the proceeds thereof to the erection of a new building upon the University Grounds, and involving the continuance of the maintenance of the said School of Practical Science, therefore be it resolved—That as no sufficient reasons exist for the continuance of the said School the sum of $5690 be struck out.

While the motion was lost on division, it was indicative of the continued resistance that had to be overcome before the project came to fulfilment.

Thus was taken the final step in the process of legalizing the transformation of the School of Practical Science into an institution of professional status.

The final shot in what had been a long-extended engagement came on February 22. Provincial Treasurer Crooks asked that the sum set apart for the repair of the building then being used be expunged, seeing that the operations of the School therein would cease in a few weeks. Matthew Crooks Cameron, Leader of the Opposition, alluded disparagingly to the removal of that institution to the University, where he "thought it would prove as great a failure as the Agricultural College.[27]

[27]*Ibid.*, February 23, 1877.

4

INITIAL YEARS OF THE PROFESSIONAL SCHOOL OF PRACTICAL SCIENCE

LEGISLATIVE SANCTION having been given for the transformation of the School of Practical Science to professional status, matters moved rapidly both in the Provincial Department of Education and in the University. On May 4, 1877, Vice-Chancellor Moss gave notice in the University Senate of his intention to introduce a statute authorizing the erection of a building for the School of Practical Science on the University grounds and near the University building. A first reading of the Statute was given on June 25.

There remained the question of a site for the building. Mr. Lloyd, a Detroit architect who appears to have been consulted about the matter, suggested the southwest angle of the University lawn. Objection having been raised to this, the selection was left to a Committee of the Senate composed of Henry Holmes Croft, Professor of Chemistry, Professor James Loudon, and T. W. Taylor, a legal member of the Senate who later became Sir Thomas Wardlaw Taylor, Chief Justice of Manitoba. They chose the site of the present Engineering Building, being in some measure influenced by the wishes of the Government to have it near College Street, in order that the evening scientific lectures to artisans might be continued.[1]

At a meeting of the Senate held on June 27 Professor Croft read a communication embodying the views of the special committee and the recommendation therein contained was adopted. In accordance with the terms of the enacted statute, the committee of three, or any two of them, were empowered to fix the limits of the parcel of land to be appropriated. Upon their notification of the Provincial

[1]James Loudon, unpublished memoirs.

Secretary that this had been done, the erection of the building might be commenced. Moreover, they were given power to agree to the construction of any roads necessary to the proper and convenient use of the land for the designated purpose. In relation to present usages these authorizations represented a notable delegation of power by the governing body of the University.

The administrative difficulties that arose in the first decade of activity in the uptown School of Practical Science can be better appreciated if it is realized that the facilities there provided and the instruction offered were initially strongly oriented in the Arts direction. Much had been said by Ministers of the Blake and Mowat Governments concerning the desirability of full utilization of the resources of University College in the interests of educational economy. Moreover, University College already had a thinly technological Department of Civil Engineering which, it was thought, might be revitalized by the presence of a technical institution next door.

There is no doubt that the original intention was that the new institution should be definitely a professional school of engineering. In the preamble of the School of Practical Science Act of 1873 (36 Vict., c. 30) reference was made to the establishment of the School "for practical education in such arts as mining, engineering, mechanics and manufactures" as designed to "promote the development of the mineral and economic resources of the Province, and its industrial progress." Section 7 of the Act, relating to the nature of offered instruction, read:

> 7. The said School shall be furnished with all such appliances and apparatus as may be necessary for practical education in the hereinbefore mentioned arts, and the course of instruction therein shall be with reference to the following subjects:
>
> (1) The construction and working of machinery, manufactures, and mechanical powers in general;
>
> (2) The construction of roads, bridges, railways, water and drainage systems, and other public works;
>
> (3) Mining, and the analysis of ores and minerals;
>
> (4) The chemistry applicable to arts and manufactures;
>
> (5) And such further subjects as will promote a knowledge of the physical sciences.

That the professional engineering subjects were to be in the dominant role is obvious from the detailed enumeration of them and the

relegation to last position of the only studies that might be considered as in the arts category, namely those that would "promote a knowledge of the physical sciences." That intention was made still clearer by the suggested curriculum incorporated in the report of Adam Crooks to the Cabinet Council on June 16, 1873.[2] As has been indicated on page 45 it was predominantly of the applied science type.

While James Loudon held, in general, that where the demand for professional training is large enough, a school offering it should be entirely independent of any non-engineering faculty or college, the recommendations contained in his 1875 report to the Government were based on the implied assumption that this prerequisite had not been met in respect of the professional School of Practical Science.[3] He believed that, having regard to the state of the Province, more modest measures ought to be adopted. The needs, he thought, would be adequately and economically met by appointing a Professor of Civil Engineering in University College, by entrusting the work in Mining and Metallurgy to the Professor of Mineralogy and Geology, and securing an assistant for the Professor of Chemistry. He deprecated the expenditure of a large sum for Engineering and Applied Chemistry without any provision for what he considered to be "the still more important object—the promotion of the practical study of the physical sciences."

Loudon's emphasis on the commanding importance of the physical sciences was reflected in the report of Adam Crooks, as Minister of Education, to the Cabinet Council on January 30, 1877.[4] In enumerating the objects to be sought in the establishment of the new institution he gave first place to the encouragement of "the more practical study of the physical sciences" and second place to professional training for such as desired to become engineers after a regular course of instruction.

In view of these circumstances, it is not strange that the School of Practical Science, beginning operations as it did in the shadow of University College, should have experienced a climate more congenial to Arts studies than to those of a technological character.

[2]Attached to Order in Council of June 23, 1873.

[3]W. H. Ellis, Supplementary Report, Ontario Sessional Papers, 1875–76, vol. VIII, Part 3, no. 27.

[4]Province of Ontario, Legislative Assembly, *Journals and Appendix*, 1877, vol. X.

Writing to T. Kennard Thomson on June 15, 1906, John Galbraith expressed the view that up to 1889 the School was practically the Applied Science Department of University College.

But whatever may have been the personal reflections of those especially concerned with professional engineering education at Toronto, the policy of close relationship to the University was settled. Immediate steps had to be taken to provide the new institution with a physical home and workplace. Placed above all other considerations at that time was the necessity of getting on with the enterprise.

The designer of the School of Practical Science building was Kivas Tully. Born and trained in Ireland as a civil engineer and architect, he had come to Canada in 1844 and by 1877 had achieved eminence in a profession the duality of which was characteristic of the period. In 1867 he was appointed Architect and Engineer for the Department of Public Works for the Province of Ontario. Some seventeen years later he relinquished his engineering duties and confined himself entirely to architecture. The original Trinity College building, on Queen Street West, Toronto, was one of the better known examples of his work.

Provision had to be made in the new structure for certain specified needs of the Faculty of Arts as well as for work that clearly belonged to the field of applied science. The three-storey, red-brick building was one hundred feet long on its north face and fifty-three feet deep, with a single-storey wing forty-two by thirty-four feet extending southward from its west end. As if in sure anticipation of still greater things to come, the planners made provision for the adding of a similar wing at the east end. The limits of the original structure are readily recognized on examination of the present Engineering Building of the University. The east wall extended southward only as far as the first jog from the northeast corner. The wing at the west end, for many years used by Dr. Ellis for his classes in Chemistry, is still a lecture room.

Space was provided in the basement for practical work in Assaying, Mining, and Physics. The ground floor was devoted chiefly to Chemistry. Here were the private rooms of the Professors of Chemistry, Mineralogy and Geology, and Natural Philosophy. On the so-called first floor, more accommodation was provided for Chemistry, but the largest room was set aside for physical apparatus

and engineering models. There was, however, no engineering laboratory. That was fifteen years off. Near by was the engineering lecture room, the drafting room, and the private room for the Professor of Engineering. The second, or top, floor was made available for the work in Physiology and afforded space for a variety of equipment, including tanks for marine animals.

Invitations to bidders for the construction of the building were issued by advertisement under date of June 8, 1877. Bids were to be submitted by June 18. The contract was let soon thereafter to William J. Hughes. By early August the walls were finished up to the first floor and it was expected that the building would be ready for occupancy by March, 1878.

An important change in the heating system had, for a curious reason, to be made at the outset of construction. When the plows and scrapers were put to work on the excavation, it was noticed that the magnetic needles in the adjacent observatory were substantially affected. The heating system was consequently changed from steam to hot air so as to reduce the amount of iron used and minimize the magnetic disturbance.[5]

Even at this stage, the staff allocations to the work of the School were assumed by the public to be fixed, with the exception of the professorship of Engineering. Croft, with Ellis as his assistant, was to be in charge of Chemistry; Chapman would head Mining Engineering; Natural Philosophy lay in the hands of James Loudon; and Ramsay Wright would be responsible for Biology.[6]

Despite the comparatively rapid advancement of the physical and organizational aspects of the project, the Government was still encountering marked opposition to the enterprise in the House. On a maintenance item of $2,680, the Minister of Education, anticipating criticism, stated that for the first time there would be in the country a complete institution for practical instruction in Geology, Mineralogy, Mining, and Engineering, which would be of the greatest possible benefit to public and high school teachers and all others who required practical acquaintance with these subjects. The cost would be about one-quarter of the usual cost of such institutions.[7]

Speaking on this item in the Committee of Supply, W. R. Meredith, Member for London, expressed regret that the Minister had

[5]*Globe*, August 11, 1877.
[6]*Ibid.*
[7]*Ibid.*, February 25, 1878.

abandoned the scheme inaugurated the previous year and had made the School of Practical Science an adjunct of the University of Toronto. He would have welcomed a movement on the part of the Government to establish evening classes for workingmen, such as had been advocated in England by Professor Huxley. Crooks replied that while that desirable type of training had been introduced by the Mechanics' Institutes, with government assistance, it was necessary that young men of ability should be encouraged to devote their whole time to the study of practical science to the end that they might assist in making this a great manufacturing country. For the development of the vast mineral wealth they should have a sound knowledge of the physical sciences, especially mineralogy. The School would not be injured but would be benefited by being an adjunct to the University. For a maintenance cost of $5,000 a year it could offer many inducements to the youth of Ontario.[8]

More shafts, some of them bent with over-use, followed. Mr. Meredith thought it unjust and absurd to expect young men to come all the way from London to Toronto to be educated in these particular subjects. Classes should be started in London and elsewhere. Matthew Crooks Cameron observed that it had always been found prejudicial to put institutions of the class being considered under the shadow of a university. The School should be entirely a separate school of practical science, although a chair could have been established in connection with the University of Toronto for the School. If the old building on Church Street no longer answered the purpose, another building could have been had in the city. Mr. Lauder averred that moving the School to the University grounds was a mistake. Professors of the University would not enter into the scheme very enthusiastically unless they received extra salary. There was no demand for the peculiar teaching of this School at present, and it would be very poorly attended at first.[9] Nevertheless, the item was approved by the Committee.

But at the new building matters were advancing rapidly. Fitting up for occupancy began on June 10, use being made of much of the shelving, glass cases, tables, cupboards, furniture, and apparatus that had been used in the downtown School. Professor Croft started to move over from University College. His old laboratory, in what

[8] *Ibid.*, March 1, 1878.
[9] *Ibid.*

is now known as the Croft Chapter House, was being converted to a mining and geological museum. It was estimated that his new quarters in the School would be ready for use in a month.[10]

Of much greater significance, however, was the filling of that most vital post on the staff—the chair of Engineering. James Loudon recounts an awkward and embarrassing situation that arose in this process. In the spring of 1878 the position was practically given to William Bell Dawson, the engineer son of Principal Dawson of McGill University, on the recommendation of Professor Daniel Wilson. Dawson came to Toronto and spent some time in giving directions respecting the preparation and alteration of rooms in the new building. Strong objection having been taken to this mode of appointment, the position was then thrown open to competition.[11] Dawson did not receive the appointment.

Towards the end of June advertisements appeared in the Ontario press and two English scientific journals announcing that applications, accompanied by testimonials, for the chair of Civil Engineering, addressed to the Minister of Education, would be received until August 31. Amongst the qualifications required was a special knowledge of Applied Mechanics, Engineering (Civil, Mining, and Mechanical), Surveying, and Mechanical Drawing. The appointment was to be regarded as provisional and subject to confirmation at the expiration of the first year, if satisfactorily filled.[12]

There were nine applicants:

John Galbraith, Port Hope	Charles Levey, Toronto
Charles Guthrie, London, England	William Armstrong, Toronto
William Bell Dawson, Montreal	Frank Baker, Sheffield, England
Alexander Wilson, Belfast	Joseph Meadows, Dublin
	George C. V. Holmes, London, England

The Minister of Education, reporting to the Cabinet Council on September 23, recommended the appointment of Galbraith on the ground of his superior qualifications in both theoretical and practical knowledge. An Order in Council approved on September 28 adopted the Minister's recommendation.

While John Galbraith had already served two years as an external

[10]*Ibid.*, June 12, 1878.
[11]Loudon, memoirs.
[12]*Globe*, June 29, 1878.

examiner in Civil Engineering in connection with the University College course, following two years as an examiner in Mathematics, it does not appear that he had given any thought before midsummer of 1878 to joining the staff of the School of Practical Science. He had already reached a secure place in the profession and undoubtedly would have attained great distinction in the field of active practice had he elected to confine himself to it.

Galbraith's qualifications for academic work were excellent. He was a graduate in honour Mathematics of the Faculty of Arts, University of Toronto, in the class of 1868, obtaining the gold medal in Mathematics and the Prince of Wales Prize for highest general proficiency. To this was added the degree of Master of Arts in 1875.

It may seem strange that one who looked forward with high enthusiasm to a career in engineering should have elected to pursue his academic studies in an Arts college, rather than in a professional school. He had intended to take a course in Applied Science at McGill University, but by 1863, the year of Galbraith's registration at Toronto, the McGill course had encountered financial difficulties that brought about its suspension until 1871. Galbraith was dismayed. Fortunately, J. B. Cherriman, Professor of Mathematics and Natural Philosophy in University College, entered the scene at this moment and induced him to enrol in Arts, giving particular attention to Mathematics.[13]

To be sure, a course in Civil Engineering had been annually offered in University College for the preceding seven years, but Galbraith was not impressed. Since 1860, it had contained no technological subjects and was less rigorous in mathematics and science than the Arts course. Many years later, writing in the December, 1913, issue of *Applied Science*, Galbraith remarked that in 1863 "engineering was but a trade and a person might after serving some apprenticeship present himself for examination by the University examiners and if his test proved satisfactory he would be awarded a diploma by the University." Dr. J. B. Tyrrell, the eminent geologist and mining engineer, has confirmed Galbraith's appraisal of the inadequacy of the University College course. "When I was an undergraduate between the years 1876–1880," said he, "there were no engineering courses, or shall I call them purposeful courses, at the

[13]Association of Ontario Land Surveyors, *Annual Report*, no. 31, February 15–17, 1916.

University of Toronto. If there had been, I would certainly have taken one of them."

Upon graduation, Galbraith was articled to his boyhood ideal, George A. Stewart, Chief Engineer of the Midland Railway and a provincial land surveyor with an extensive practice. This association was prophetic. Years later, Stewart's son, Louis B. Stewart, became Professor of Surveying and Geodesy in the School, and later in the University of Toronto. In that role, and always as "Louis B.," he is remembered with admiration and affection by the older Toronto graduates in engineering.

The young apprentice, armed with a copy of Rankine's *Civil Engineering*, lent to him by Stewart, was at first employed on the construction of the Lakefield branch of the Midland Railway. Then came a survey of the extension of this road from Lindsay to Beaverton and, in addition, plenty of land surveying.

In May, 1869, he received an appointment on the engineering staff of the Intercolonial Railway, and was employed on the construction of the Rivière du Loup section of that road until September, 1870, when he accepted a position as contractor's engineer in the Matapedia Valley.

Appointed resident engineer on the Midland Railway extension from Beaverton to Orillia in September, 1871, he remained until that portion had been completed, when he was placed in charge of the work from Orillia to the Georgian Bay. By reason of financial difficulties, work was stopped in November, 1874, and from then to the spring of 1875, he engaged in private work.

Desiring some experience in mechanical engineering, Galbraith spent a large part of the year 1875 as a mechanical draughtsman with a company manufacturing locomotives, steam engines, grain elevators, and general machinery, at Portland, Maine.

Then in November, 1875, came an appointment as a division engineer on the Georgian Bay branch of the Canadian Pacific Railway, followed, in 1877, by an assistantship to Thomas Ridout on an exploratory survey for the Canadian Pacific Railway from the French River to Vermilion Lake. These engagements were supplemented by private practice at Port Hope, Ontario.

Robust, clear-headed, well-informed, resolute, with ample professional experience in responsible posts, Galbraith could not fail to be recognized as a most promising candidate. True, he was short

of stature, slow of speech, with an occasional lisp, but one very quickly discovered him to be a man of great and balanced strength.

Compared with those of Galbraith, the professional qualifications of William Bell Dawson were less impressive. Dawson was eight years younger and his practical experience amounted to three years on railway and other surveys, as compared with Galbraith's ten years, much of which had been spent on construction. No doubt Dawson would have been an able occupant of the chair of Civil Engineering, for he subsequently achieved distinction, particularly as Superintendent of the Tidal and Current Surveys of Canada.

To guide him in selecting an applicant for appointment, the Minister of Education sought the advice of James Loudon, whose interest in the affairs of the School of Practical Science was still lively. He had no hesitancy in recommending Galbraith, who was appointed with the title of Professor of Civil Engineering, which was subsequently broadened to Professor of Engineering.[14] Years afterwards, when President of the University, Loudon declared publicly that this was the best piece of work he had ever accomplished either for technical education or for the University.[15]

Meanwhile, arrangements had been made for the government and financing of the School by Orders in Council approved on June 28 and July 4, 1878. The declared object of the institution was to supply instruction in Mining Engineering and the Mechanical and Manufacturing Arts. As a provincial enterprise it was placed under charge of the Minister of Education. Internal management and discipline was entrusted to a Board consisting of the lecturers and instructors. A Dean and a Secretary of the School were to be appointed from amongst the members of the faculty by the Lieutenant-Governor.[16]

The prescribed subjects of instruction differed from those set out in the School of Practical Science Act of 1873 (36 Vict., c. 30) and also from the ones recommended by Adam Crooks, as Provincial Treasurer, on June 16, 1873.[17] They were to be:

(1) Chemistry, Theoretical, Practical and Applied;
(2) Applied Mathematics;
(3) Descriptive Geometry;

[14]Loudon, memoirs.
[15]*Globe*, December 22, 1900.
[16]O.S.P., 1879, vol. XI, Part 6, no. 67.
[17]Attached to Order in Council of June 23, 1873,

(4) Physics and Mechanics;
(5) Mineralogy and Geology;
(6) Metallurgy;
(7) Botany and Zoology;
(8) Mechanical Drawing;
(9) Engineering and Mining;
(10) Surveying;
(11) Machinery.

Graduating departments involving groups of subjects were not fixed, but the duration of the regular course of instruction was set at three years or sessions, each being divided into two terms. On successful completion of a full course, a student would be granted a diploma entitling him to the standing of an "Associate of the School." Certificates of attendance were, under certain circumstances, given to those who did not complete the regular course.

Students seeking the diploma of the School were required to pass an entrance examination in the subjects of the Intermediate High School examination, but standing obtained on certain equivalent examinations would be accepted.

Facilities were offered to occasional students for attending lectures or practical courses and, in addition, for instruction to artisans, mechanics, and others in subjects useful in their different callings.

The fixing of the detailed programme and course of study and instruction, and the fees payable, was left to the Board, subject to the approval of the Lieutenant-Governor.

Schedule "B" of the Order in Council of July 4, 1878, consisted of the memorandum of arrangements with respect to the School of Practical Science entered into by the Minister of Education, on behalf of the Province, and the Council of University College. In accordance with it, students of the School were enabled to attend the lectures given by the staff of the Departments of Chemistry, Mathematics and Natural Philosophy, Mineralogy and Geology, and Natural History. Moreover, whatever appliances and apparatus were found by University College to be necessary for its own students would be made available for the instruction of students of the School. The annual expense of maintenance was to be borne by University College and the School of Practical Science in accordance with certain defined principles.[18]

Soon after his approval of these regulations and arrangements,

[18]O.S.P., 1879, vol. XI, Part 6, no. 67,

the Lieutenant-Governor named as the personnel of the Board the following persons:

H. H. Croft, Professor of Chemistry
E. J. Chapman, Professor of Mineralogy and Geology
James Loudon, Professor of Mathematics and Natural Philosophy
R. Ramsay Wright, Professor of Biology
— — — — Professor of Engineering
W. H. Ellis, Assistant to the Professor of Chemistry.

Professor Croft, who had been the Professor of Chemistry and Experimental Philosophy on the opening of the University of King's College in June, 1843, was named as Chairman of the Board, although the regulations actually required the appointment of a Dean. It was not until 1906, however, when the School of Practical Science became the Faculty of Applied Science and Engineering of the University of Toronto, that the designation of Dean was borne by the head of the professional school of engineering at Toronto. Professor Ramsay Wright was made Acting Secretary.

Appointed on September 28, Galbraith did not attend the initial meeting of the Board, held on October 1, but was present at the next meeting, on October 5. The tardiness of the appointment must have complicated the task of the new appointee, who came to a difficult and novel post. His name did not appear as a member of the staff in the first calendar.

In public advertisements dated August 9, the Government announced that interested persons might obtain information concerning the programme and courses of study and instruction for the 1878–79 session of the School in a Prospectus to be obtained either directly from the Department of Education of the Province or from Professor R. Ramsay Wright, at the School of Practical Science building. But it was not until September that it was ready. By this time it was too late for prospective students to appear at an entrance examination. Admission was therefore granted to the first year largely on the basis of practical experience.[19]

There were three available departments in which the diploma could be obtained:

(1) Engineering (Civil, Mechanical, and Mining);
(2) Assaying and Mining Geology;
(3) Analytical and Applied Chemistry.

[19] *Ibid.*, Part 4, no. 23.

The course offered in the Department of Engineering was intended, the Prospectus said, to qualify students to prosecute the various branches of engineering. During the first two years the work was for the most part common to all students enrolled in the School. During the second year the student was required to select from the three branches (Civil, Mechanical, and Mining) the one that he intended to pursue, and the studies of the third year would be arranged in conformity therewith.

Incidental to the understanding that the School of Practical Science would concern itself not only with technological matters but would also assist in furthering scientific studies generally in the University, the Board undertook to provide certain courses suitable for medical students. These were to be in the extra-professional and more purely scientific studies laid down in the new medical curriculum. It was hoped that students in Medicine might be able to take advantage of the commodious laboratory accommodation and acquire that personal familiarity with the use of physical and physiological apparatus which forms such an admirable training for the scientific medical man. To this end an outline of courses offered by the Department of Chemistry, the Department of Biology, and the Department of Natural Philosophy was included in the prospectus.

Encouragement of scientific study on the part of students of University College was given by making provision for classes in a Department of Mathematics and Natural Science.

Seven continuing students were enrolled in the three-year course for the diploma in Engineering in the session of 1878–79. Of these, three had been previously engaged in practical engineering at the workshops of the Northern Railway and entered the School with the object of gaining a more scientific and complete knowledge of their profession, as well as that of obtaining a practical acquaintance with allied subjects. These three elected to take the Mechanical Engineering course and the remaining four were in Civil Engineering. No regular students entered either the Department of Assaying and Mining Geology or that of Analytical and Applied Chemistry at that time.[20]

Twenty-three occasional students were enrolled for classes in Chemistry and Biology, taking one or both subjects. These, except in one instance, were students from the two medical schools of the city. In addition, 110 students from University College, drawn from

[20] *Ibid.*

all four years, received instruction in Chemistry, Biology, and Mineralogy, or combinations of these subjects. Thirty-eight from the Toronto Veterinary College attended lectures in Chemistry.[21]

The abundance of "non-regulars" in attendance proved to be an embarrassment to the staff. On January 11, 1879, the Acting Secretary, on behalf of the Board, informed the Minister of Education of the necessity of discouraging occasional students from applying for practical instruction in Mineralogy and Geology because of the deficiency of space and apparatus, and want of time on the part of the professor "having to give practical instruction to so many students of University College."

From the first, it was apparent that the Board of the School had been impressed with the need for keeping the annual expenditures low. In its endeavour to conform, the Board was confronted with some difficult departmental situations. Early in December, 1878, Professor Ramsay Wright asked for $3,000 on behalf of the Department of Biology for physiological apparatus, but encountered the opposition of Professors Croft and Chapman, who at a later meeting unsuccessfully moved that no more than $1,000 be spent for apparatus and supplies in respect of any subject or branch of a subject during the year 1879. On December 23 Professor Wright asked that the Board request the Minister of Education to withdraw the item of $3,000 from the requisition for physiological apparatus on the ground of the dissent mentioned, and at the same time to avoid discussion of the merits of the question outside the Board and misconception or further misrepresentation of his object in asking for the appropriation. This action was approved by the Board.

That old controversies die hard was abundantly exemplified with the inception of the professional School of Practical Science. Speaking in the Legislature on February 19, 1879, to his motion for a return covering the operations of the School of Technology and its successor from January 1, 1874, to date, Robert Bell, member for Toronto West, expressed the opinion that 70 per cent of the students attending the School of Practical Science were in attendance at University College or other places of instruction. The School had been diverted from its original object by being taken away from the mechanics and given to a professional class. It was being professionalized. A. W. Lauder, of East Grey, asserted that the institution had been established for the mechanical classes and that the recent

[21]O.S.P., 1879, vol. XI, Part 6, no. 67; *ibid.*, 1880, vol. XII, Part 3, no. 13.

expenditures on it had to a great extent been useless. The Government should endeavour to put it to the purposes for which it had been founded. The present location was unfortunate. If the Minister of Education had selected a site with the idea of putting it out of the reach or knowledge of the class who would be likely to attend it, he could not have obtained a better one than he did. Mr. Meredith quoted Edward Blake's statement made at the time the downtown School was founded that it was to be a separate institution and that a portion of the endowment of University College should be devoted to its purposes. The University should assume the School as one of its branches, and thus relieve the Province of the burden of its maintenance. Mr. Merrick agreed.

Replying to these castigations, Adam Crooks justified the Government's policy. The School was "extremely serviceable," especially in the Department of Mining Engineering, which was so useful in the circumstances of the Province, and for the first time put the country in a position to turn out civil engineers with superior attainments. There were strong hopes that the School would provide immense benefit to the Province at very small expense.

The truth is, that the proper role of the School was still very imperfectly understood by the public, including some members of the Legislature. In illustrating the handicap of this public ignorance, John Galbraith used to tell of a would-be pugilist who inquired about the terms for a course in practical science, which he understood to mean boxing.

Apart from those relating to the Department of Engineering, the changes appearing in the prospectus for 1879–80 were of a minor nature. In the revision of the curriculum for that department, however, the hand of Galbraith the engineer was apparent. The declared object of the programme was more moderately described as being "to afford the necessary preliminary preparation to students intending to enter the various professional branches of engineering."

For the first year the course was made common to all three branches (Civil, Mechanical, and Mining). At the commencement of the second year each student was required to select the branch that he desired to pursue. The studies of the second and third years would then be arranged in conformity therewith.

To the prescription for the first year, Chemistry and a modern language, either French or German, were added. The work of the

second year was, in general, to be common to the three branches. Civil and Mining Engineering students were grouped for Spherical Trigonometry, Geometrical Optics, Plane Astronomy, Surveying, Practical Astronomy, and Principles of Geodesy. Crystallography was offered only to those in Mining Engineering. French or German was required of all. For the third, or final, year the programme was common to all students, except that those registered in Mining Engineering took Assaying, Mining Geology, Crystallography, and Palaeontology. In all branches the indicated modern language alternative was still prescribed.

The requirement of French or German in all three years arose from the paucity of engineering literature in English at that time and to some extent from Galbraith's personal attainments as a linguist and his recognition of the desirability, for a member of a profession, of being familiar with some language other than his own, particularly one of a scientifically active people.

A vacation task, at which early students of the School professed to be appalled, was the thesis. A subject would be given at the end of the session and on this the student was required to write a thesis, accompanied by any necessary drawings and specifications. The value of this production would be taken into account in determining his standing at the next examination.

The autumn term of 1879–80 began with twelve regular students proceeding to the diploma of the School. Of the special students, the largest group was made up of those from Medicine, 24 of them being enrolled in Biology. Lesser numbers of students took other subjects. From University College, 137 attended Chemistry classes, other subjects attracting fewer. The Toronto Veterinary College sent 38 for Chemistry. Similar numbers of students in the various classes were in attendance during the spring term of 1880.

For the session of 1880–81, the total enrolment of regular and special students was approximately the same as in the previous session.[22] As may be seen from Table I, the enrolment rose slowly over the first six sessions. The School in those days was an institution on trial and the attitude towards it was one of hesitancy and caution. Then, in 1884–85, registration took a leap upward. Thereafter, the numbers steadily grew, save for a minor recession between 1894 and 1897.

[22]O.S.P., 1881, vol. XIII, Part 3, no. 13.

TABLE I

ANNUAL ENROLMENT AND GRADUATION OF APPLIED SCIENCE STUDENTS IN THE SCHOOL OF PRACTICAL SCIENCE FOR THE PERIOD 1878–1905 AND IN THE FACULTY OF APPLIED SCIENCE AND ENGINEERING FOR 1906–1914

(Enrolment is shown for the second term of each session. Regular students were those proceeding to the diploma or first degree. Special students were those taking parts only of regular graduating courses.)

Session	Number of students in regular courses	Total number of regular and special students	Number graduating at end of session	Cumulative number of graduates	Total number of Applied Science teaching staff
1878–79	7	8	—	—	2
1879–80	12	14	—	—	2
1880–81	13	16	1	1	2
1881–82	18	18	3	4	2
1882–83	21	21	3	7	2
1883–84	21	26	5	12	2
1884–85	35	43	5	17	2
1885–86	48	62	5	22	3
1886–87	47	56	6	28	4
1887–88	52	58	16	44	4
1888–89	59	64	11	55	5
1889–90	65	73	14	69	7
1890–91	89	91	13	82	7
1891–92	111	127	19	101	9
1892–93	122	143	27	128	11
1893–94	107	141	22	150	11
1894–95	92	125	19	169	14
1895–96	86	100	13	182	14
1896–97	114	135	15	197	14
1897–98	135	146	16	213	14
1898–99	150	156	24	237	14
1899–00	184	193	34	271	15
1900–01	228	231	32	303	17
1901–02	288	290	41	344	19
1902–03	336	340	56	400	20
1903–04	399	403	70	470	21
1904–05	477	482	53	523	27
1905–06	533	533	87	610	34
1906–07	621	622	95	705	39
1907–08	720	721	112	817	47
1908–09	754	755	149	966	54
1909–10	725	727	143	1109	60
1910–11	770	771	150	1259	63
1911–12	793	793	—	1259	68
1912–13	675	675	108	1367	70
1913–14	626	627	142	1509	72

The low ratio of sessional enrolments to the number of teaching staff disclosed by the Table for the years 1878–84 might appear to indicate that Galbraith and Ellis, who were responsible for all of the instruction in applied science, with not over 26 students between them in all the years, had light teaching loads. Actually, these were anything but light. Approximately the same amount of time had to be spent in lectures and practical work for a small number of students as for one several times larger. For example, Galbraith himself taught all of the strictly engineering subjects in all years. By 1883–84 this involved the giving of no less than fourteen distinct lecture courses and the supervision of the related field work and drafting.

Greatly increased provision for laboratory work consequent on the additional facilities offered by the School of Practical Science had a marked effect on the extent of the practical instruction of University College students. For example, while formerly work in the chemical laboratory had been allotted only about thirty hours in all, during one year of the undergraduate course, it became, with the new accommodation and equipment, an important branch of study throughout the whole course of four years.[23]

In the summer of 1879 it became known that Professor Croft, along with President McCaul, would retire at the end of the year. At his last appearance as Chairman of the Board of the School of Practical Science he announced his intention of presenting to the School the greater part of his library, a collection of minerals, and certain pieces of apparatus belonging to himself personally. This was done early in 1880.

Appointment of a new Chairman of the Board was delayed until the beginning of the next session. In the interim, Professors Chapman and Loudon acted as Chairmen.

Once again, the estimates for the School encountered hard sledding in the Legislature. In Committee of Supply on February 12, 1880, the Minister's request for $5,400 was attacked by W. R. Meredith as beyond what public opinion would countenance for five or six students. Much more could be accomplished by granting aid to Schools of Art and Design, which would develop manufactures more than Schools of Practical Science. The existing institution

[23] *Ibid.*

was in no sense serving the object for which it was established, that is to provide instruction for the manufacturing classes.

Meredith repeated his charge of the year before that the Government was departing from the 1871 view of Edward Blake that the School of Technology ought not to be separate from the University. At the same time, Meredith deplored the fact that the School of Practical Science was practically an adjunct to it. He appeared to regard the academic climate of the University as unfavourable to the kind of instruction he had in mind.

Adam Crooks, in reply, pointed out that in its first session the School had given instruction to 194 students, regular and special, and in the second session to 286. He justified that degree of separation from the University which experience showed to be essential for the success of a technological institution.[24]

As was to have been expected, administrative frictions arose during the settling-in process. Professor William Herbert Pike, who came from England to succeed Professor Croft as Professor of Chemistry and also as a member of the Board of the School, did not lighten the burdens of that body. Able, but ruthless, he "drove everything before him, winning his victories at the point of the bayonet."[25] He was not a man for concessions or compromises, and sometimes engaged in incredible manœuvres to achieve his objectives.

At a meeting of the Board held on March 29, 1880, Dr. Pike announced that there was at that time absolutely no provision for the teaching of students proceeding to the diploma in Analytical and Applied Chemistry. As he could receive no students in this course he urged that the Minister of Education be consulted with respect to the desirability of deleting from the Prospectus the paragraphs that referred specifically to the department mentioned. On April 20 he objected to the insertion of these paragraphs in the new Prospectus.

An incident of a different type was the insertion of a statement by Professor Ramsay Wright in the Board minutes of October 4 pointing out that the Government had failed to pay for his services as Secretary of the Board, although the Minister of Education had

[24]*Globe*, February 13, 1880.
[25]John A. Cooper, *University of Toronto Monthly* (February, 1903).

frequently indicated that such would be done. A claim of $200 had been made but had been ignored. The Board resolved that the Minister be asked to make immediate settlement.

More delicate was the situation that arose in the seating of a new Chairman of the Board. According to James Loudon[26] it was generally believed that the Minister had promised the post to Dr. Pike, but Dr. Daniel Wilson, the President-designate of University College, succeeded in getting himself appointed. This was said to be made possible by adding Ethnology to the School curriculum and at the same time appointing Wilson as lecturer in the subject and as a member of the Board and Chairman of it.

When Wilson appeared at the Board meeting of October 11, 1880, and took his seat as Chairman on the authority of a letter from the Minister, he was, according to Loudon, assailed "in the most violent language" by Dr. Chapman for thrusting himself upon the Board with no proper right to sit. Strange to say, Dr. Wilson made no reply to the attack but proceeded with the business of the meeting when Chapman had finished.[27]

At the next meeting, held on October 26, an Order in Council dated October 9 was read whereby Ethnology was formally added to the subjects of instruction in the School and the Professor of Ethnology, Dr. Wilson, was named a member of the Board and its Chairman. At the same time, Professor Alfred Baker, Registrar of University College, was appointed Secretary to the Board.

Ever since the founding of the School of Technology in 1871 the view had been held, not only by the Minister responsible for educational matters but also generally in the Legislature, that evening instruction should be offered to artisans, mechanics, and others in subjects that would be useful to them in their different callings. Arrangements for such instruction were pledged in the Regulations of June 28, 1878, relating to the School of Practical Science. In November, 1880, the Minister expressed to the Board his desire that it should give such practical effect to the relevant regulation as it thought most beneficial in attaining this declared object. Long consideration followed, and in the autumn of 1881 the course of evening lectures commenced.

[26]Loudon, memoirs.
[27]*Ibid.*

The series began on November 14, 1881, with a lecture by President Wilson. The next day he wrote in his journal:

> Gave the inaugural lecture last night at the School of Practical Science for a set of courses of evening lectures which it has cost me a good deal of trouble to organize. Subject: "The Practical Uses of Science in the Daily Business Life". A good audience, and fair promise of success. All the lecturers have now agreed to take part, which, considering the strong opposition at first, and the persistency with which it was upset last winter, is very satisfactory to me.

Lectures were given also by Professors Loudon, Pike, Wright, Galbraith, and Ellis on topics within their respective fields. A total of 193 persons attended the course.[28]

Towards the end of 1880 a disruptive staff problem had arisen, out of which came a decision of fundamental importance to engineering education at Toronto. It turned on the question of what aspects of Chemistry should be taught to students of the School of Practical Science and who should be responsible for teaching them. An incipient staff controversy was revealed at the meeting of the Board of the School held on November 19 when a letter from an unidentified person was read stating that Dr. Ellis's title should be "Instructor in Chemistry," or "Assistant," and that his primary duties were "those required for the purposes of the School of Science, thus relieving the Professor of Chemistry [Dr. Pike] therefrom."

On December 3 the Board resolved "that the Chairman communicate with the Minister of Education with a view to learning the exact position of Dr. Ellis as a member of the Board, his relations to Professor Pike, and his duties as an instructor." The Minister's reply was read on December 10 but it "conveyed information that was not of such character as to throw any additional light on the matter."

After four months of consideration by those concerned, a solution appeared to be near. In a resolution of April 8, 1881, the Board recognized Dr. Ellis "as an independent teacher of the School of Science, and member of the Board, while Dr. Pike in his independent position as a Professor of University College is required to carry out his part in fulfilling the agreement between the College and the School of Science." The Board recommended that the teaching of

[28]O.S.P., 1882–83, vol. XV, Part 6, no. 19.

Analytical and Applied Chemistry, which formed part of the instruction of the School of Practical Science, should be undertaken by Dr. Ellis, while each of them should have independent control of their separate laboratories.

Not unnaturally this academic tempest was disturbing to President Wilson. On May 27, 1881, he wrote: "Much worry today about the Chemical Department and the rival rights and claims of the Professor and the School of Practical Science Instructor, in which the Minister of Education interposes only to increase the trouble. Thus far the School of Practical Science threatens to give more trouble than all the College duties."[29]

The resolution of April 8 did not remain unchallenged. On November 11, 1881, Dr. Pike moved "that the resolution of the Board of April 8, 1881, being founded on the memorandum of the Minister of Education of March 18, 1881, and the Minister of Education having stated in his memorandum of November 5, 1881, that it is founded on a misconception of his meaning, it is hereby rescinded."

It was moved in amendment by Professor Galbraith, and carried, "that the Board approve of the course of lectures and practical instruction now proposed by Dr. Ellis, and for the proper carrying out of the same hereby directs that he be granted the supervision of the Upper Chemical Laboratory, and requests that he prepare as soon as possible an estimate of the necessary funds."

At the next meeting, December 16, Professor Pike unsuccessfully moved that the reply of the Minister of Education to the Galbraith resolution of the Board having been read, the resolution and also that of April 8, 1881, referring to the subject be rescinded.

The Chairman of the Board, President Wilson, reported at the meeting of February 24, 1882, that the Minister of Education had agreed to have the matter of the relations between Dr. Pike and Dr. Ellis referred to the Lieutenant-Governor in Council. He submitted a statement of the case on behalf of the Board which he proposed should be laid before the Lieutenant-Governor. It was decided that this should be forwarded to the Provincial Secretary.

But in the existing mood of march and countermarch this procedure was abandoned. The Chairman informed the Board on

[29]Sir Daniel Wilson, unpublished journal.

March 10 that three of its members had asked that an opportunity be afforded for reconsidering the proposed appeal to the Lieutenant-Governor in Council. He had learned from the Attorney General (Premier Mowat) that it would be impossible for the Council to give attention to the subject until after the adjournment of the Legislature. Upon reconsideration, it was decided that the statement should not be forwarded to the Provincial Secretary, but that instead a reply to a communication of the Minister of Education dated February 13 be sent informing him of its position in these terms:

> That this Board, while deeply regretting that any difference of opinion should exist between the Minister of Education and themselves regarding the management of the School, would respectfully submit that in directing Dr. Ellis to undertake certain work and in assigning to him the use of the Upper Chemical Laboratory, they took a step which in their opinion the interests of the School demanded, and in performing this duty they are of the opinion that they acted strictly within their powers.

Another turn in the tortuous process was to come. For its meeting of April 14, the Board had before it a letter from the Minister of Education, accompanied by an extract from a letter addressed directly to him by Dr. Pike relative to the dispute. The situation called for quick and decisive action. A Committee was immediately set up, consisting of President Wilson and Professors Chapman, Loudon, Wright, and Galbraith, to draft a reply expressing the opinion of the majority of the Board on the case stated by Dr. Pike.

Three days later the Board convened, with Pike and Ellis absent. The report of the Committee was approved and sent to the Minister. Pike remained away from the next three meetings, but Ellis attended two.

Then, at the meeting of December 8, 1882, with Dr. Pike and Dr. Ellis present, the Board was confronted with another disconcerting incident. Professor Galbraith drew its attention to the appointment by the Council of University College of a Committee for the purpose of considering and reporting on certain alleged impediments to Professor Pike's teaching which had arisen in consequence of a resolution of the Board of the School. Thereupon, the Board resolved "that while acknowledging the right of the College Council to consult with them in regard to the teaching of University College students, it begs to state that in their opinion it is beyond the province of the Council to pronounce upon the official relations between Dr. Pike and Dr. Ellis." Dr. Pike followed by giving notice that at

the next meeting of the Board he would move for increased laboratory accommodation. There is no record of his having made the motion.

Finally, after more than two years of tension, the matter was settled. Towards the end of December, 1882, the Minister of Education recommended to the Cabinet Council the adoption of the view of the Chairman of the Board that Dr. Ellis should head a department in the School and be placed in an analogous position to that of the Professor of Engineering. As a result, under an Order in Council approved on December 30, Ellis was appointed Professor of Applied Chemistry, and authority was given to provide him with whatever accommodation and apparatus might be required for his work. As a parting shot of the minority, it was moved by Professors Wright and Chapman that the resolution of December 8, 1882, relating to the action of the University College Council be reconsidered. It was not.

Resentments created by long-continued controversies do not immediately subside. A letter from Professor Galbraith directing the attention of the Chairman of the Board to the insufficiency of an apology made by Professor Chapman to the complainant at the previous meeting was read at the Board meeting of February 9, 1883. Then, on October 5, Galbraith raised a question of privilege and withdrew from the meeting. Whatever it was that precipitated this episode is not known, but President Wilson in a journal entry of October 13 refers to "a most irritating personal conflict between Professor Chapman and Professor Galbraith." The minutes of the next meeting of the Board, held on October 20, record that the question of privilege raised by Professor Galbraith had been settled to the satisfaction of the Board. The turmoil ceased and the remaining six years of the School's operation under a Board were relatively calm and fruitful.

By no means was the atmosphere of the School continually charged with strife or uneasy relationships. Many minor happenings characteristic of a professional school in the making were the subject of comment or record. In March, 1881, the Board directed the Secretary to devise means for preventing students in Engineering from using the elevator. Whether from jurisdictional caution or from greater propriety of conduct on the part of Arts students, they were not mentioned. A year later the Board decided to close in the ele-

vator, probably as much for deterrent as precaution. The next year the Board solemnly ruled that the attendant would be allowed to sleep in the building when the weather required his presence in the School overnight, but he was not allowed to bring dogs about the building. Late in 1884 the exceedingly unsatisfactory condition of the water closets oppressed the eminent scholars of the Board. The Provincial Architect was asked to abate the nuisance complained of, and Professor Pike undertook to report on the subject to him.

Despite occasional stressful moments, the School had been moving steadily forward. Added details about courses appeared in the Calendar for 1882–83. The course in Ethnology, given by President Wilson to non-engineers, was described. There were greater laboratory facilities provided in Chemistry for Dr. Pike, and the upper laboratory that had been set aside for Dr. Ellis was devoted exclusively to Applied Chemistry.[30]

But a serious staff overload existed in Engineering. The Professor was required to give personally all of the instruction in the engineering subjects, no appropriation being available for an assistant. Lack of suitable textbooks added to the burden. In the session 1883–84 Galbraith delivered fourteen distinct courses of lectures, of which twelve ran through both terms of the session, the other two being confined to the second term only. In addition, he gave practical field instruction in Surveying and Astronomy, and in the drafting room was solely responsible for the work in Drawing, Structural and Mechanical Design, Mapping and Topography. Added to this was a course on the Theory of the Steam Engine, given in the evening classes for artisans, mechanics, and workmen.

Believing that this assignment was far too varied and grossly excessive in amount for one instructor to cover with justice either to himself or to his students, the Board pressed for the appointment of an assistant to take charge of the instruction in Drawing, Descriptive Geometry, Surveying and Levelling, Spherical Trigonometry, and Astronomy and Geodesy. At the very least, it asked for a Fellow in Engineering.[31]

Perhaps the most significant development in the session 1883–84 was the establishment by the University Senate on February 1, 1884, of the professional degree of Civil Engineer, available to the gradu-

[30] *Ibid.*, 1884, vol. XVI, Part 6, no. 28.
[31] *Ibid.*

ates of the School of Practical Science under certain prescribed conditions. One of these was that the candidate must have spent at least three years on approved engineering work after leaving the School. Prior to that time, it had been the custom for anyone seeking professional status to assume the designation of C.E. as soon as he attained the position of Assistant Engineer, though he did so without a test of his scientific knowledge or any diploma from a properly constituted authority.[32]

An incidental provision of the statute establishing this degree was that all previous statutes of the University relating to degrees or diplomas in Civil Engineering were repealed. This officially terminated the Department of Civil Engineering in University College.

Space problems were also arising. The room used as a drawing and lecture room was becoming inconveniently crowded and the Board felt that by the end of 1883 an extension to the building would be necessary in order to provide for the session of 1885–86.[33]

Steadily, the pressure on staff and facilities increased. In the autumn term of 1884 there were 41 students, regular and special, enrolled in the Department of Engineering. The Board re-urged, as a least measure, the appointment of a Fellow in Engineering to assist Galbraith. Additional room for his department was imperative. It was thought that this might be provided by the construction of another wing, to join the south side of the existing building at its east end.

At the same time, a revision of the inadequate system of heating was essential in order to obviate the destruction occasioned by the freezing of liquids in glass apparatus and the bursting of water pipes in cold weather. So serious was this at times that it put a stop to all practical work in the affected laboratories.[34]

At last, with the beginning of the session 1885–86, Galbraith had a Fellow in Engineering to assist him. The appointee was E. W. Stern, a graduate of 1884, who was later to attain distinction as a consulting engineer in New York.[35]

Congestion of quarters was still unrelieved. The room that had been in use as a library was taken over for drafting purposes. With only two lecture rooms, and several lectures often scheduled for

[32] *Ibid.*, 1885, vol. XVII, Part 2, no. 5.
[33] *Ibid.*, 1884, vol. XVI, Part 6, no. 28.
[34] *Ibid.*, 1885, vol. XVII, Part 2, no. 5.
[35] *Ibid.*, 1886, vol. XVIII, Part 1, no. 5.

the same hour, the laboratories and drafting rooms had to be utilized as lecture rooms, much to the discomfort of both the lecturers and their classes, as well as of the students who were attempting to use these rooms simultaneously for their proper purposes. Moreover, a large room on the ground floor was needed for an engineering laboratory, equipped with a machine for testing the strength of materials, and, in addition, an experimental steam engine. All the available space in the building having been occupied, the Board reported that unless the existing structure was enlarged it would be necessary, should the current rate of increase in the number of applications for admission continue, to limit registration next year. In its report for 1885, the Board again drew the attention of the Government to the serious inadequacy of the heating equipment for the building, a deficiency that had long remained unremedied. It pressed for the preparation of plans for building extension and building overhaul.[36]

One of the most significant events of the formative years of the School was the founding, early in 1885, of the Engineering Society of the School of Practical Science. Oddly enough, a conversazione of the Literary and Scientific Society of University College was indirectly the occasion of its organization. Various student organizations had undertaken to prepare lectures and experiments for this annual event, and H. L. Bowman, of the graduating class in engineering, suggested that the School organize a society and assist in the entertainment. Although the proposal was not favourably received by many, the late Dr. T. Kennard Thomson, long an eminent foundation consultant in New York, but then an engineering student in his second year, resolved to see the thing accomplished.[37]

In November, 1884, Thomson invited Professor Galbraith, Dr. W. H. Ellis, all of the second- and third-year students, and four of his non-engineering friends to dinner, for no apparent reason other than hospitality. After coffee, he proposed that an Engineering Society be formed by undergraduates of the School. Galbraith, although constitutionally cautious and deliberate, immediately commended the idea and said that the organization should be started at once. Thereupon, a committee of three students was appointed to frame a constitution and by-laws. By March the Society was in full swing.

[36] *Ibid.*
[37] *Varsity*, December 3, 1902.

Invited to take the presidency of the new organization in its formative period, Galbraith consented and held the post for three years. The Society then being firmly established, it was agreed that the presidency should henceforth be held by a student. Galbraith's immediate successor was the able and energetic H. E. T. Haultain, who many years later was to join the staff as Professor of Mining Engineering. A roster of presidents of the Society from its inception contains the names of many of the ablest members of the profession that have emerged in Canada.

The Engineering Society has undoubtedly played an important role in the self-development of the engineering student body at Toronto, and as liaison, in facilitating the administration of the School and the Faculty that succeeded it. Valuable technical papers and addresses have been given, not only by outside engineers of eminence, but, particularly in the earlier years, by students themselves. The problem of wide diversity of technical interests was met by the organization of constituent clubs, each of which is, in general, concerned with a particular branch of applied science. The publications of the Society have been of professional as well as social value and the co-operative sale of student supplies lightens the financial burdens of students not a little. Engineering undergraduates at Toronto have a joint pride in their own organization, the oldest engineering society of continuous existence in Canada.

Resuming its pressure in 1886, the Board asserted that the full benefits of the available teaching could not be realized owing to the want of adequate accommodation for both lecture and laboratory work. The deficiency in heating had become still more serious with the extension of the chemical laboratories. Sanitary arrangements were so poor as to constitute a danger to the health of those using the building.

Galbraith was still overworked. The Fellow in Engineering—David Burns, who succeeded E. W. Stern in the autumn of 1886—afforded some relief in the practical work of the drafting room and the field. But it frequently happened that the Fellow had to superintend the work carried on in two rooms simultaneously, with marked impairment of effectiveness. The Professor continued to carry the full lecture load and was engaged in teaching seven hours a day, with no time for preparation, meetings, administration, or correspondence. Once more the Board urged, as it had done three years earlier, the appointment of a relatively senior assistant, this

time an Assistant Professor of Engineering, to take charge of Geodesy, Practical Astronomy, Surveying, Descriptive Geometry, and Spherical Trigonometry. He needed to be a good mathematician, with a thorough knowledge of the differential and integral calculus, and at the same time a practical surveyor. Galbraith observed that "there is no other engineering school in the world where such a variety of work is thrown on one professor as in the School of Practical Science."[38]

Handicapped by shortage of staff and space, the School was forced to limit its activities. By 1886 the course in Engineering was restricted to Civil and Mining Engineering. Students desiring to become mechanical engineers were permitted to enter as special students and receive restricted instruction in the Principles of Mechanism, Theory of Machines, and Drawing. Those interested in electrical engineering might obtain some special instruction in Drawing, Mechanical Engineering, and Electricity. These offerings fell far short of full courses in Mechanical and Electrical Engineering.

The Board, in its report for 1886, invited the consideration of the Government to the desirability of adding a Department of Architecture to the School. In its view, "nearly all the important branches required for a well-trained architect were already taught." The Calendar for 1887–88 suggested that those wishing to pursue Architecture as a profession should take the regular course in Civil Engineering. They might, if they chose, enter as special students.[39]

Especially noteworthy was the report of the Board for 1887.[40] In it Professor Galbraith set out at some length his concept of the field that should be covered by the Department of Engineering in the School. Having in mind that all the engineering instruction was given by the Professor himself for the first seven years of operation, and that for the succeeding two years his sole support came from the services of a single graduate assistant, the work had to be confined to the broad course in Civil Engineering, wherein all branches of science bearing upon the profession were considered. Special attention was paid to those studies in which the young engineer had little or no chance of getting instruction or help from his professional superiors while engaged on actual work.

[38] O.S.P., 1887, vol. XIX, Part 2, no. 7.
[39] *Ibid.*
[40] O.S.P., 1888, vol. XX, Part 2, no. 7.

Continual applications from students who wished to become mechanical engineers, all of which had to be refused, had convinced Galbraith that a full course in Mechanical Engineering ought to be instituted. It was not at all necessary to set up and equip shops as an incident thereto. Those students who had not already gained shop experience could obtain it in industry before attendance at the School, during vacations, or subsequent to graduation. Rather than spend a large amount of money in building, equipping, and operating workshops, the Government might better establish an engineering laboratory. In it, students could learn by experimenting with machines and instruments and under controlled conditions acquire knowledge that could not be obtained in shops.

The Professor of Engineering forcefully restated the claims for increased staff and space that had been advanced by the Board in several previous reports. His own obligations were to give all lectures except those in first-year Descriptive Geometry, superintend part of the practical work in Drawing and Surveying, perform the duties of a dean and registrar, carry on all correspondence requiring professional knowledge, and generally to administer the affairs of the Department. The subjects taught could not be treated in an elementary or popular way, and in consequence unremitting study and investigation on the part of the teacher was imperative. Without further assistance he could not assume responsibility for a new course in Mechanical Engineering or properly discharge the duties pertaining to the single existing course. Once again, he asked for the appointment of an Assistant Professor.

Early in 1888, Galbraith made publicly known his view that the staff should be sufficiently large to enable the instructors to be specialists in their respective departments. A professor ought not to be required to teach Astronomy and the Theory of the Steam Engine—not to speak of half a dozen other subjects equally incongruous. Referring to a hypothetical instructor, obviously himself, he observed that a Professor of Engineering in an institution not a thousand miles from Toronto was placed in a much more awkward position than a certain Oxford Professor of Chemistry and Botany. When the latter visited a foreign chemist he introduced himself as a Professor of Botany; when he visited a botanist, he became a Professor of Chemistry![41]

[41] *Varsity*, April 7, 1888.

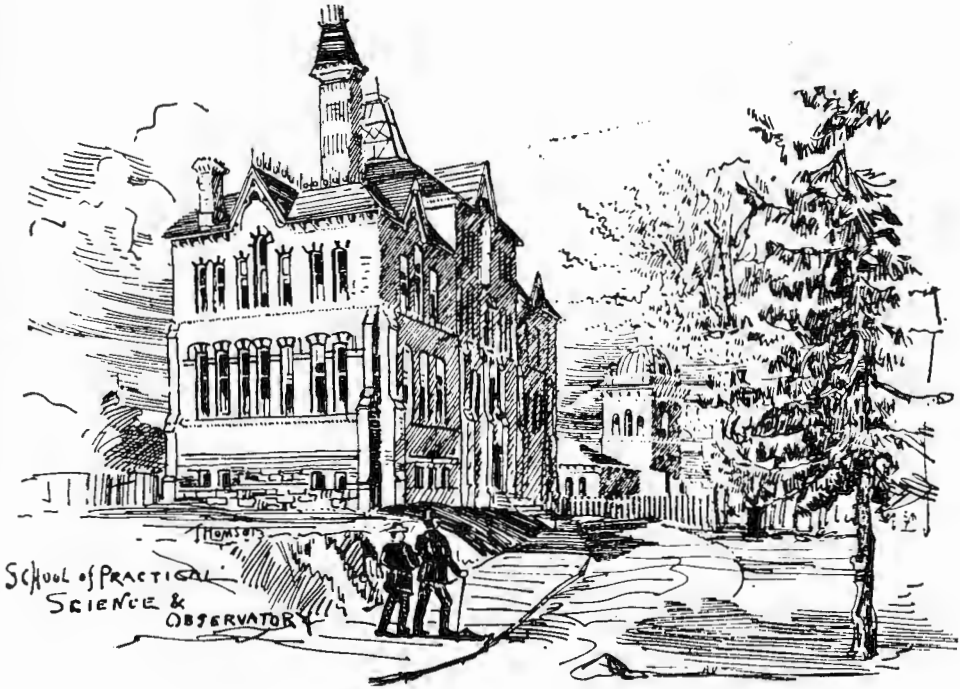
A most welcome addition to the engineering staff of the School came in December, 1888, when Louis Beaufort Stewart was appointed Lecturer in Surveying. Although trained under the traditional pupilage system, he applied himself with such diligence and understanding to private study under articles to his father, George A. Stewart, that his skill in solving intricate mathematical and technical problems in surveying, astronomy, and geodesy was the envy of many who had spent years in college. His experience in field operations in Ontario and the Canadian West was already impressive. Quiet in manner, utterly devoid of pretence, but invariably kindly, courteous, and considerate, he brought to his task a solid competence that assured distinguished service to the School. The subjects assigned to Stewart were Geodesy, Land and Engineering Surveying, Hydrographic Surveying, Applied Astronomy, Descriptive Geometry, and Map and Topographical Drawing.

With this strong reinforcement of staff, the Board, on the initiative of Galbraith, urged in its report for 1888[42] that the time had arrived for inaugurating a regular course in Mechanical (including Electrical) Engineering. It was not as yet prepared, however, to provide practical instruction in an engineering laboratory, a prime requisite in any properly equipped engineering school. That most necessary facility was no less imperative for the education of civil engineers and architects. Its equipment and direction were outlined in detail for the guidance of the Minister, then the Honourable G. W. Ross.

The Board raised again the question of establishing a course in Architecture, and asked for the appointment of a lecturer in it. He would need to possess also the qualifications to serve as an instructor in Engineering so that he might relieve the Professor of Engineering of some of his excess duties and obviate the appointment of an additional lecturer in Engineering. Economy and efficiency were both to be served.

Evidently the persistence of the Board was having effect. During the year 1888 the Minister of Education came to the conclusion that the time had come for putting the School on a broader basis, in part through the introduction of the practical or laboratory method of teaching in all departments. To guard against the possibility of serious mistakes, he decided to make a personal inspection

[42]O.S.P., 1889, vol. XXI, Part 1, no. 6.



Original building of the School of Practical Science, Toronto, erected 1877–78. (From the *Globe*, June 15, 1889.)

Enlarged School of Practical Science building, about 1907.

John Galbraith on canoe trip to Hudson Bay, 1881.

John Galbraith on steps of School of Practical Science (Engineering) building, about 1908.

of the more important institutions in the eastern United States that were engaged in the same type of work as that contemplated for the School of Practical Science. He arranged for Galbraith to accompany him. Together they visited Cornell, Lehigh, Columbia, Stevens Institute of Technology, and the Massachusetts Institute of Technology. As a result of that visit plans were matured for the erection and equipping of a large extension to the original School building.[43]

Late in 1889 construction commenced. Referring to this stirring event in his inaugural address as President of the Engineering Society, John A. Duff spoke of the new addition as one "in relation to which the present building will be quite insignificant," and added, "nothing but the most uncomfortable overcrowding has forced the authorities to move."[44]

Meanwhile, another significant step had been taken. An Order in Council, dated April 16, 1889, authorized the setting up in the Department of Engineering of a division of Mechanical (including Electrical) Engineering co-equal with Civil (including Mining) Engineering. It became operative with the opening of term in October. An important requirement of the course was that before receiving his diploma a candidate must present certificates of having had at least a year's experience in some of the trades or occupations connected with engineering, such as that of a machinist, pattern maker, moulder, or steam engineer.

The first term of 1889–90 opened under the direction of the Board, which was soon to be superseded. Seventy students were taking either the full regular courses leading to a diploma or part of them. In addition, there were four in Analytical and Applied Chemistry classes, and thirty in Assaying and Mining Geology.

Large numbers of Arts students attended classes in Chemistry and in Mineralogy and Geology. Between 100 and 150 students in Medicine took Chemistry, in the teaching of which Dr. Ellis, the Professor of Applied Chemistry, had a large share. On the revival of the Faculty of Medicine in 1887, Ellis had also become Professor of Applied Chemistry in that Faculty. The chair was abolished in 1892, but he continued for some time to serve as Lecturer in Chemistry and also Lecturer in Toxicology.

[43]John Galbraith, "The Function of the School of Applied Science in the Education of the Engineer," *University of Toronto Monthly*, vol. I (1901), no. 5.
[44]*Transactions of the Engineering Society*, 1889–90.

Transfer of the science departments that were embraced in the work of the School of Practical Science from University College to the University of Toronto in 1889, under the terms of the University Federation Act (Revised Statutes of Ontario, 1887, c. 230), brought to an end the arrangement between the School and the College. In order that students of the School might continue to enjoy the advantage of the instruction offered by these departments, the Senate passed a statute on October 18, 1889, affiliating the School to the University. This was confirmed by Order in Council on October 30, 1889, and approved by the Lieutenant-Governor on November 2.

By Order in Council, adopted on November 6, 1889, the School of Practical Science was reorganized. A Principal was appointed and the management entrusted to a Council composed of a Chairman and the Professors, Lecturers, and Demonstrators appointed as the teaching faculty of the School. The regulations remained substantially the same as those adopted by the Lieutenant-Governor in Council on April 18, 1889.

Gradually, the old régime had given way to the new. Its last official action was taken at the meeting of October 11, 1889, when Cesare J. Marani, a graduate of 1888, was appointed Fellow in Engineering.

5

A PRINCIPAL AND COUNCIL TAKE OVER

FROM NOVEMBER 6, 1889, direction and control of the School of Practical Science was, under the Minister of Education, exercised solely by the Principal and Council, all of them being members of the teaching staff of the School. Thereafter, as one would expect, the policies and procedures were determined by those whose full-time interests lay in the field of applied science. The curriculum that had been announced for 1889–90 by the superseded Board was followed, but important changes were to come for the following session.

The Order in Council effecting the transformation named John Galbraith as Principal and Chairman of the Council, but he retained his appointment and responsibilities as Professor of Engineering. Ellis and Stewart were the only other members of Council at the outset. C. J. Marani was confirmed in his post of Fellow in Engineering and William Ross became Fellow in Applied Chemistry. These two, being below the rank of Demonstrator, were not members of the Council.

The newly constituted three-man Council held its first meeting on December 13, 1889. Stewart acted as Secretary. The proceedings were brief, consisting merely of consideration of the estimates for the year 1890. The annual salaries agreed upon were: Galbraith, $2,500; Ellis, $1,500; Stewart, $1,000.

It became the duty of Galbraith, as Principal, to report to the Minister of Education at the end of 1889 on the work of that year. This included the spring term of the session 1888–89 and the autumn term of 1889–90. All of the former, and a part of the latter, had been under the administration of the Board, of which the Chairman was President (then Sir Daniel) Wilson.[1]

The new Principal reminded the Minister that his personal over-

[1]Ontario Sessional Papers, 1890, vol. XXII, Part 2, no. 6.

load was still unrelieved. As Professor of Engineering he himself gave instruction in Applied Statics and Dynamics, Strength and Elasticity of Materials, Theory of Construction, Hydraulics, Thermodynamics, Theory of the Steam Engine, Principles of Mechanism, and Machine Design. If a Lecturer in Architecture were appointed, Galbraith wrote, he could teach the theory pertaining to Strength of Materials and Theory of Construction, while the Demonstrator necessary for the engineering laboratory might take over the Principles of Mechanism and the Theory of Machine Design. If these appointments were made, an additional assistant to relieve the Professor of Engineering of a part of his work would not be necessary. Relief had become increasingly urgent by reason of the large amount of administrative work that had been thrown upon him, as Principal, by the changes in the organization of the School.

Galbraith suggested that if there were any doubt about the extension to the School building being fully completed by October, 1890, an effort should be made to have as many rooms finished as would obviate overcrowding in the next session.

Some relief in the matter of space for Analytical and Applied Chemistry had come from another direction. With the completion of the Biological Building, the Department of Biology was removed to it. The rooms thus made available were immediately utilized for a lecture room and as laboratory accommodation for advanced students.

Heating was still a troublesome question. Reversing the decision of 1877, when steam was abandoned for hot air in deference to the protests of the Magnetic Observatory staff, Galbraith suggested that the hot-air furnace in the existing building be replaced by a steam installation before the next academic year. Apparently the vitiation of magnetic observations through the presence of many iron radiators in the neighbourhood which had been feared did not occur, for it was not until 1898 that the magnetic work was transferred to Agincourt.

Regulations governing the operations of the School for its first full session under the new administration were issued by an Order in Council adopted March 19, 1890. Five regular departments offering three years of work leading to the diploma of the School were recognized. These were:

(1) Civil Engineering (including Mining Engineering);
(2) Mechanical Engineering (including Electrical Engineering);
(3) Architecture;
(4) Analytical and Applied Chemistry;
(5) Assaying and Mining Geology.

As a result of the persistent urgings of Galbraith before the Board, and later as Principal, two appointments to the staff were made in April, 1890, which were to have far-reaching effect on the development of the School. Charles Henry Challenor Wright, a Civil Engineering graduate of 1888, was made Lecturer in Architecture, and Thomas Reeve Rosebrugh, who was an honour graduate in Mathematics and Physics of the University of Toronto and an 1889 graduate of the School, became Demonstrator in the engineering laboratory.

The new appointees were markedly different in personal characteristics. Wright, intensely active, keenly interested in sports, and accustomed to the practical outlook of a contractor's organization, liked working with people and welcomed ever widening contacts with them. Endowed with a talent for organization and management, he was to give outstanding administrative assistance to Galbraith in the critical years of the School. To teaching enthusiasm he joined an ardent support of athletics and a passion for furthering the academic and personal welfare of students—an inheritance fortunately passed on to his son, Professor W. J. T. Wright. Rosebrugh, shy and reserved, was a dedicated student and original investigator in the fields of mathematics and the physical sciences. He had a passion for accuracy and clear, succinct statement, devoid of any trace of ambiguity, exaggeration, or flamboyance. His mind was an example of that "clear, cold logic engine" of which Huxley spoke.

The new regulations were having a stimulating effect on enrolment. In the autumn of 1890 there were in all years 65 regular students registered in Civil Engineering, 16 in Mechanical Engineering, 5 in the new Department of Architecture, and 2 in Analytical and Applied Chemistry. The number of students in Mechanical Engineering was double that in the preceding session.[2]

Crowding had been lessened by the substantial completion of the new addition to the building, although the engineering laboratory

[2]*Ibid.*, 1891, vol. XXIII, Part 2, no. 4.

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[2]*Ibid.*, 1891, vol. XXIII, Part 2, no. 4.

was not in working order at the end of 1890. The Departments of Civil Engineering, Mechanical Engineering, and Architecture were housed in the new structure, while the Departments of Analytical and Applied Chemistry and Assaying and Mining Geology remained in the original building.

Wright had charge of the work in Architecture and of Theory of Construction for both Engineering and Architecture students. Rosebrugh gave the lectures in Mechanical (including Electrical) Engineering and also those in Dynamics and the Theory of Compound Stress.

The Principal's report for 1890 forecast important changes to come. Council was considering raising the standard of entrance. Failure of a large proportion of the candidates in the first-year examination indicated that the admission requirements were too low. French or German ought, in the view of Council, to be made compulsory, as there was no time for students to attend classes in these subjects while at the School.

Growing interest in electrical matters suggested the institution of a separate regular course in Electrical Engineering. But to make this possible it would have been necessary to acquire a substantial amount of electrical apparatus, such as dynamos, motors, accumulator cells, batteries, rheostats, lamps, and measuring instruments.

Experience had shown the desirability of lengthening the course to four years in order that students might take full advantage of the new engineering laboratory that was soon to be available. Moreover, there was a growing desire on the part of students and graduates that a bachelor's degree in Applied Science be established, and the Council saw no good reason for not taking steps to have this brought about.[3]

Following the disastrous fire of February 14, 1890, which destroyed the east wing of the University building, the School placed several rooms at the disposal of the University authorities. Sir Daniel Wilson, in a diary entry, expressed his annoyance at Principal Galbraith's insistence on obtaining the permission of the Minister of Education for the partial occupancy of the School building. Yet this structure was under the control of a department of the Government, and not of the University administration.[4] Moreover,

[3]*Ibid.*

[4]Sir Daniel Wilson, unpublished journal.

Galbraith came of a cautious race, and he had not forgotten the two-year struggle of the early eighties to obtain and retain space for the teaching of Applied Chemistry in the original School building.

The close relation that then existed between the School of Practical Science and the Provincial Government made it necessary for the Principal to be wary and discreet. The Minister of Education, the Honourable George W. Ross, liked to hold a close rein on the School. He personally welcomed the members of the University Senate to the School's assembly hall for convocation purposes until they were able to obtain more suitable quarters. In January, 1894, Galbraith had to seek the approval of the Minister for a public debate to be held on School premises. A year later he asked if the School might be permitted to hold its conversazione in its own hall.

The opening of the session of 1891–92 brought the addition of two new members of Council: Dr. Arthur P. Coleman and Cesare J. Marani. Dr. Coleman, a graduate of Victoria University, Cobourg, won his doctorate at Breslau, and for nine years had been Professor of Geology and Natural History at Victoria. As Professor of Assaying and Metallurgy in the School of Practical Science, he undertook the formidable task of teaching Mineralogy, Geology, Lithology, Metallurgy, Mining, and Assaying. His subsequent eminence as one of the world's leading geologists overwhelmingly justified the wisdom of the choice.[5] Marani had been promoted to the position of Lecturer in Sanitary Engineering, and Rosebrugh, already a Council member, was made Lecturer in Electrical Engineering.

Regulations remained unaltered, except that "Department 2" had become Mechanical and Electrical Engineering, an acknowledgement of the growing importance of electrical technology. Attendance was steadily rising. There were now 127 regular and special students, most of them being in Civil Engineering and Mechanical Engineering.[6]

Typical of many later recurrences of the space problem, were departmental complaints of inadequate quarters, only a year after the initial occupancy of the new addition. The need of the Department of Mechanical and Electrical Engineering for suitable rooms for experiments on the illuminating powers of arc and incandescent

[5]O.S.P., 1892, vol. XXIV, Part 2, no. 11; *ibid.*, 1893, vol. XXV, Part 1, no. 3, p. 273.

[6]O.S.P., 1892, vol. XXIV, Part 2, no. 11.

lamps was urged. It hoped that rooms on the fourth floor (the "attic") could be fitted up. Architecture wanted two rooms on the same floor for model-making and several others for the preparation of stereopticon slides. The Lecturer in Architecture should be moved to a third-floor room in the tower so that other shifts might be made. Dr. Coleman asked that as soon as possible the Department of Assaying and Mining Geology be transferred from the dark, damp, inconvenient basement rooms that were then used to more commodious and suitably lighted quarters in another part of the building. It was hoped that when the six rooms that had been occupied by the University Library after the fire were vacated the needs would be met for the time being.

With relief and pride, announcement was made in the 1891–92 Calendar that the facilities of the School were being largely increased by the installation of testing machines, an experimental steam plant, pumps, turbines, tanks, and a variety of electrical equipment suitable for engineering experimentation. The Department of Architecture was acquiring large numbers of models, casts, and photographs. It was with not a little elation that the undemonstrative Galbraith referred, in an address given late in the session, to the three major testing machines as "of the latest and most improved design" and as having "no duplicates in existence."[7]

Acquisition of splendid equipment in the ample space of the engineering laboratory had immediately directed attention to the possibility of carrying the work beyond the limits of the three-year diploma course. Commencing in the autumn of 1891, a sessional course of instruction known as "the fourth year" was offered in each department. Its purpose was to provide advanced work and to enable students to carry on experimental investigation in the laboratories with less interruption from attendance at classes than was possible in the ordinary undergraduate course. A special certificate would be given to those who properly qualified themselves in this extra year.

A year's notice of the institution of simplified but stiffened entrance requirements was given. Effective on October 1, 1892, candidates for admission to a regular course in any department were to

[7]John Galbraith, *Technical Education*, an address delivered at the opening of the engineering laboratory of the School of Practical Science, Toronto, February 24, 1892.

present certificates of having passed the matriculation examination in any university of the British Dominions, or the High School Leaving Examination of Ontario. Council reserved power to alter the conditions to meet exceptional cases, provided the candidates were sufficiently prepared to take their places in the classes.

Before the session 1892–93 began, these conditions were clarified and made more definite. An applicant would be admitted if he presented a certificate of a year's experience in a recognized engineering, architectural, or manufacturing firm, and passed an examination in certain specified subjects. A year later, in order to ensure the possession of satisfactory proficiency in elementary mathematics by the candidates, Arithmetic was added to the subjects.

In his report for 1891,[8] Galbraith, as Principal, took occasion to record his philosophy of practical instruction in a school of applied science, views that anticipated those he expressed at the formal opening of the engineering laboratory on February 24, 1892.

Technical education, as Galbraith saw it, might be classified into two broad divisions: manual training and theoretical training. In a school for the former, the teachers should be expert tradesmen, chosen with special reference to their power of imparting instruction. The exercises in the use of the various tools and materials should be arranged so as to give the students a grasp of the principles underlying the processes of manufacturing and the uses of the necessary tools and appliances. The material equipment of a school of this type would consist largely of the tools, machines, and apparatus used in manufacturing establishments. While it was advantageous to give some elementary theoretical instruction, the main objective ought to be the training of the hand.

On the other hand, training of a theoretical or scientific character, in an institution such as the School of Practical Science, could be undertaken only by teachers of scientific outlook, thoroughly versed in the theories relating to their several departments. They should be acquainted with the processes to which materials are subjected in modern manufacturing and construction, not primarily to teach these processes but rather to point out the application of theory to them. Laboratory equipment should consist of machinery, appliances, and apparatus specially designed for investigating the

[8]O.S.P., 1892, vol. XXIV, Part 2, no. 11.

scientific principles underlying ordinary manufacturing and constructional processes. To a very large extent, such equipment would differ materially from that in a manufacturing plant. Even where it was of the same kind, it would be used for an entirely different purpose. Thus, a steam engine in a school of applied science would be used, not for actuating lathes, planers, or drills, but for investigations in the economical use of steam, of the effects of changes of speed, cushioning, counterbalancing, or jacketing. There was practically no opportunity to study such matters as these when the machine was doing its ordinary work. Hence the equipping of the new engineering laboratory had been carried out in accordance with the principles enunciated. Exact measurement lies at the foundation of all quantitative investigation; consequently apparatus had been provided for producing certain desired effects, and appliances had been furnished for measuring the extent of these effects in each case.[9]

Despite the passage of the years, Galbraith's views concerning the proper role of practical instruction in a professional school of engineering still remain sound educational philosophy.

Responsibility lay heavily on Galbraith in selecting and supervising the installation of all equipment in the engineering laboratory. Rigid governmental practices and procedures were often hampering. In May, 1891, he was notified of a ruling by the Commissioner of Public Works that all equipment was to be ordered by the Department of Public Works, and that full and complete specifications and information with respect to all needed articles were to be forwarded preliminary to the request for them. Whereupon, Galbraith replied that he could not do this without incurring a great delay in ordering, and that in many instances one thing depended upon another and, moreover, a great many things could not be ordered until other articles upon which they depended had been delivered. No more was heard of the matter. Galbraith was trusted, for when he made an error he frankly admitted it.

Sound knowledge of equipment and constant watchfulness were necessary in assuring that the needs of the School were properly met. The manufacturer of the large torsion machine was asked to make several changes and improvements in it. The maker of the dynamometer for measuring engine power was given detailed instructions as to what was wanted. The supplier of the hundred-ton testing machine was reminded that a foundation plan had not yet

[9] *Ibid.*

been furnished, although the time for the delivery of the machine had elapsed. The press of the hydraulic testing machine leaked and must be put aright.

Galbraith's letter-books record not only many important orders and instructions in his own handwriting, often illustrated with sketches, but also numerous others written by members of his staff with his approval. Rosebrugh orders books, Coleman orders equipment, Marani cancels an order given a plumber, Wright orders books and "a case of pigeon holes."

With the session of 1892–93 a reorganization of departments became effective.[10] The new list of subjects offered was as follows:

(1) Civil Engineering (including Sanitary Engineering);
(2) Mechanical and Electrical Engineering;
(3) Mining Engineering;
(4) Architecture;
(5) Analytical and Applied Chemistry.

Sanitary Engineering had been attached to Civil Engineering largely as a service to Architecture. Unfortunately, C. J. Marani, the Lecturer in the subject, resigned on the first of October because of the insufficient salary inducement offered by the School—a condition not unknown in later years.

Mining had finally been given a status independent of Civil Engineering and the diploma course in Assaying and Mining Geology disappeared. The change was made possible in the summer of 1891 by the appointment of Dr. Coleman. Action needed to be taken then, if ever, for Principal George M. Grant, of Queen's University, regardless of the existing courses in Mining Engineering and Assaying and Mining Geology in the School of Practical Science, had been strongly urging that if a School of Mining were to be set up in the Province, it ought to be at Kingston.

With evident reference to what was being planned at Toronto, he observed, in an address given on January 10, 1889, at Queen's, that it was not necessary to centre in one place all special schools devoted to the learned professions, to the mechanical arts, and to the varied industrial development of the country. When that is attempted, said he, it is quite evident that it is the glory of one particular institution that is desired, and not the general good of the country.

[10] *Ibid.*, 1893, vol. XXV, Part 1, no. 3, p. 273.

Returning to the matter in his convocation address of November 8, 1889, the Principal asserted that the forthcoming report of the Mining Commission would show that the proper place for a School of Mines was at Kingston.[11]

The report of the Commissioners did not support Grant's contention.[12] The five Commissioners were: John Charlton, M.P. (Chairman); Dr. Robert Bell, Assistant Director, Canadian Geological Survey; Archibald Blue, Deputy Minister of Agriculture and Secretary of the Ontario Bureau of Industries; William Coe, Explorer and Miner; and William Hamilton Merritt, F.G.S.

In the portion of the report devoted to educational training, the Commissioners had this to say:

> It is hardly creditable to our province, with its excellent schools for primary and higher education, that no suitable provision is made for a thorough course of instruction in mining engineering and metallurgy, especially as the country is believed to be rich in minerals, and that most of the ventures hitherto made to raise and treat the ores have resulted in failure through want of skilled knowledge to carry on the operations. The School of Practical Science provides a part course in both subjects by the instruction given in civil engineering, chemistry, mineralogy and geology, and the most obvious plan would seem to be to strengthen that school by the addition of one or two professors of good standing and furnish it with a first-class mineralogical museum and appliances for the extraction of metals from their ores.
>
> It may be said that a school of this kind ought to be located at some point convenient to the working mines, where practical operations could be witnessed, as is the case in Michigan and also in several European countries. But the Houghton School has its reputation yet to make, and in view of the eminent success of such institutions as the Columbia School of Mines, the Massachusetts Institute of Technology, the Royal School of Mines, London, and the Ecole des Mines, Paris, it would be rash to say that a similar school in Ontario could not prosper in its chief city and attached to the provincial university. It would be at least an experiment to establish a new school far out from the centre of population, where a complete and independent staff of professors and instructors would require to be maintained, instead of utilizing an institution already established and well equipped to give instruction in the scientific part of the course; and a good course in the sciences must always be an essential part of the training in the technical schools.

While the separate Mining Engineering course as then instituted at Toronto gave a good educational background in the field of applied science, it lacked specialized practical emphasis. The matter

[11]The *Globe* of January 12 and November 11, 1889, reports these activities at Queen's.

[12]Province of Ontario, Royal Commission on the Mineral Resources of Ontario and Measures for their Development, *Report*, 1890.

was put squarely before the Province by Galbraith in his report for 1892 in the remark that "if it is the intention of the Government to establish in Ontario a School of Mines, the most practical and economical way of doing it will be by completing the equipment of the School of Practical Science. . . . mining engineers cannot be properly trained in a school unfurnished with the expensive equipment required for training civil and mechanical engineers."[13]

In the same report, Coleman laid bare in detail the equipment needed for Mining. With the existing apparatus, only one student at a time could work in Assaying. For the subjects of Metallurgy and Ore Dressing, there were no models for illustration, no equipment, and no collection of ores or furnace products, except for the private one of the Professor. The collection of minerals was most incomplete. Indeed, despite the richness of Ontario in mineral resources, there was no respectable collection of rocks, ores, and minerals to be found in the Province, even in its capital city.

A bold plan to meet the space needs of Mining Engineering and related departments, and at the same time to lessen the degree of separation between the School of Practical Science and the Faculty of Arts of the University in the matter of Chemistry, was put forward by Dr. Ellis in a letter to Edward Blake, the absentee Chancellor[14] of the University, dated April 13, 1892.[15] The proposal was that the University take over and teach all Chemistry, Pure and Applied, in the proposed new Chemical Building, and that the School assume responsibility for Geology, Mineralogy, Mining, and Metallurgy, for which all the space in the old part of the School Building would be turned over to the School on completion of the Chemical Building. Blake informed the Minister of Education of the contents of the letter, but Ross replied that at a conference which he had held with Galbraith and Ellis, the Principal had expressed strong opposition to the scheme. Evidently Galbraith feared a revival of the controversies of the early eighties with respect to the teaching of Chemistry. The matter was dropped.

Practical work in Mining Engineering was begun in 1892 by

[13]O.S.P., 1893, vol. XXV, Part 1, no. 3, p. 273.

[14]From 1876 to 1890 Chancellor Blake's political activities at Ottawa were his chief concern. For the period from 1892 to his resignation as Chancellor in 1900 he was almost continuously absent in England. The intervening two years were, however, ones of distinguished and invaluable service to the University.

[15]The Blake Papers, University of Toronto Archives, AR XVI, Box 114, Doc. 231.

W. E. Boustead, Fellow in Assaying and Metallurgy, but did not go beyond Assaying and Blowpipe Analysis until 1895. Steps were then taken to equip a milling room and the work was completed in 1896. A stamp mill, a vanner, a crusher, and other apparatus necessary for the separation of minerals on a substantial scale were installed. But the need of equipment for treating refractory gold ores and smelting and refining other ores, and of large additions to the metallurgical collection, still existed. The difficulties experienced at Toronto in getting large-scale practical instruction in mining and metallurgy under way were paralleled at the School of Mining, Kingston, and at McGill University.

In the spring of 1894, the School of Mining at Kingston, made a significant announcement, the first of its kind in Canada, that a mining laboratory would be built and equipped to give the requisite practical instruction to mining students. Friends of Queen's, individuals and corporations, interested in the development of mining, undertook to present machinery and apparatus towards the School's first equipment. There must have been tardiness in carrying out the plan, as the laboratory was apparently not ready until the autumn of 1896, that is at the same time as similar equipment was made available for students at the School of Practical Science, Toronto. Principal Galbraith, Dr. A. P. Coleman, and George R. Mickle, Lecturer in Mining, had long urged the procurement of the necessary apparatus for the Toronto School, but the funds had not been forthcoming. To these happenings at Toronto, the Queen's reaction was tempestuous. Calvin reported it in these words:

> Now Grant, and the supporters of this new school believed that the Government were entrusting them, by this action [the establishment of the School of Mining and Agriculture in 1893], with the teaching of mining engineering for the Province of Ontario. Great was their surprise when, in 1894, the Government added a department of Mining to the School of Science at the University of Toronto, to which, in the nature of things, their support would be given more fully than to the Kingston school. Grant and the Governors of the School protested vigorously, without result. The Principal withdrew for a time from the work of the School of Mining, because the Government would not undertake to be responsible for its development. He wrote to Sir Oliver Mowat [Premier of Ontario] that as Principal of Queen's he would not be identified with any "one-horse affair". The Government continued, even increased, their annual aid to the Kingston school, but no request for more substantial help was made to them for another five years.[16]

[16]D. D. Calvin, *Queen's University at Kingston: The First Century of a Scottish-Canadian Foundation, 1841–1941* (Toronto, 1941).

The years moved on, and insufficiency of funds for higher education in Ontario still sustained the rivalry of Queen's and Toronto for favours from the public purse. Following the traditional policy of the University of Toronto administrations before him, President James Loudon opposed the grant of public money to denominational and other universities outside the provincial institution.[17] Referring to the demands of Queen's, he observed in 1900 that "should the Government choose to ignore the claims of its own child, either the adoption must be complete and the child subject to full control, or else the money must be given to irresponsible hands to expend."[18]

In the Province of Quebec instruction in mining and subjects related thereto had been offered at McGill since 1872, but there was no special mining laboratory in which practical operations in crushing, milling, and ore treatment could be carried on until the Macdonald Chemistry and Mining Building was opened in December, 1898, that is, two years after facilities became available at Kingston and Toronto.

Requests for additional equipment were, at this time, being put forward by other departments at Toronto. The Department of Analytical and Applied Chemistry reiterated the needs it had voiced the year before. The Department of Surveying and Astronomy was still short of chains, tapes, and copies of drawings. The Department of Architecture wanted cases and other furniture for the fourth floor, not to mention books, drawings, photographs, and models. Duplication of certain electrical apparatus was urgently required by reason of the rapid increase in the numbers of students taking electrical subjects. There was a need for dynamometers and for fourth-floor accommodation for experiments on the illuminating powers of arc and incandescent lamps.

These needs for further support in the way of equipment and space were thrust upon the administration of the School by a steadily mounting enrolment. Civil Engineering registration still remained high, although the numbers were declining. Mechanical and Electrical Engineering had proven to be highly popular. Enrolment in it for the first term of 1892–93 was 52, as compared with 30 the year before, and 16 in 1890–91.

[17]H. H. Langton, *James Loudon and the University of Toronto* (Toronto, 1927).
[18]A. L. Clark, *The First Fifty Years: A History of the Science Faculty at Queen's University, 1893–1943* (Kingston, n.d.).

Distribution of enrolment was markedly changing with the years. Whereas in the first term of 1890–91 the registration of undergraduate students in Civil Engineering was 74 per cent of the total enrolment, in the corresponding term of 1893–94 it was only 30 per cent. Meanwhile, Mechanical and Electrical Engineering had risen from 18 to 57 per cent of the total. The numbers proceeding to the diploma in other departments still remained relatively small.

The post-graduate year, leading to the degree of Bachelor of Applied Science, was attracting students. In 1892–93 nine were working in the engineering laboratory and two in the chemical and assaying laboratories. An urgent need in this connection was a considerable increase in the number of books in the library of the School.

Development of the work had proceeded to such an extent that in his report of 1893, the Principal alluded to the need of a Lecturer in Applied Mechanics. This appointment would make possible a redistribution of duties that would enable the staff to give a greater amount of instruction in heating, ventilation, house sanitation, roof and bridge design, and the testing of materials of construction. At the same time, a Fellow in Electrical Engineering ought to be appointed to relieve in some measure the Fellow in Mechanical Engineering. A Lecturer was required in Metallurgy, Mining, and Ore Dressing who, in addition, could take charge of a portion of the laboratory work associated with these and related subjects.[19]

Repeated urgings in previous reports had eventually brought the equipment of the School approximately up to the standard thought to be adequate in 1893. But adjustments in accommodation were still needed. The fourth floor, or attic, still remained unfinished and idle. More room was required for the mineralogical and geological collections. The accommodation in the dark basement quarters was wholly unsuited for blowpipe and mineralogical work. Glazed cases were necessary for the display of specimens which were currently stored out of sight in sets of drawers. As the large steam engine could not satisfactorily be used for thermodynamic experiments and also as a source of power for the electrical equipment, a small auxiliary engine or motor was needed.[20]

Although encumbered by the details of administration, Galbraith

[19]O.S.P., 1894, vol. XXVI, Part 2, no. 3, p. 297.
[20]*Ibid.*

was shrewdly on guard against anything that might prove embarrassing to the School. In September, 1893, a member of the Legislature sent him some ore samples, apparently with the suggestion that some member of the staff be directed to report on them. Galbraith replied that he had no authority over members of the staff, except in respect of the training of students, and suggested that his correspondent write either to Ellis or to Coleman. "The School, as such," said he, "is not responsible for any expert opinions or reports." That remained its policy, as it does the policy of the Faculty that succeeded it.

On its part, the student body was jealous of the good name of the School, even in the burlesque of student politics. In the spring of 1894, a motion was introduced in the Literary and Scientific Society of University College—"The Lit"—aimed at excluding students of the School of Practical Science from membership, for which they were still eligible. According to the Arts view, as expressed by the mover, School men "are mugwumps, who never attend the Society meetings, sell their votes to both sides, and then don't vote." Confronted by this shattering charge, School turned out in force at the next meeting to submerge the anti-scientists. The obnoxious motion was withdrawn.

Indicative of the interest that diploma holders had in the newly established post-graduate year was the granting of the degree of B.A.Sc. to eleven candidates in 1893, the first year in which they might receive it.

With the session of 1894–95 came another relative drop in the enrolment of Civil Engineering, which now attracted only 23 per cent of the diploma students. The percentage of students enrolled in Mechanical and Electrical Engineering had risen to 57, while Mining Engineering, responsive to improved practical facilities, accounted for 13 per cent.

Long-continued pressure for the enlargement of the staff was at last having effect. And well it might. Galbraith himself was carrying all the lectures in Dynamics, Strength and Elasticity of Materials, Hydraulics, Thermodynamics, and Theory of the Steam Engine.

Significant in the light of subsequent events were certain appointments to the staff that became effective with this session.

John A. Duff, who had been Fellow in Civil Engineering since October, 1891, became Lecturer in Applied Mechanics. An honour

graduate in Physics and an 1890 graduate of the School, he had a combined engineering and military experience that commended him to an educational institution. Moreover, for three years he had acted as the first Principal of the Toronto Technical School.

In answer to the combined urgings of Galbraith and Coleman, George R. Mickle was, at the same time, appointed Acting Lecturer in Mining Engineering. Before entering the School he had obtained his B.A. in honour Classics. After graduating in Civil and Mining Engineering in 1888 he spent two years in graduate work in Mining at Freiberg, Saxony. For some time he had practised as a mining engineer in Sudbury. In the course of the years he became the first Professor of Mining. Students who took Metallurgy from him as a minor subject were kept in good humour by his dealing in generalities, rather than quantitative considerations. Thus treated, the subject came to be known as "Micklelurgy."

An additional appointment that was to be of great significance in the years to come was that of Robert W. Angus as Fellow in Electrical Engineering. Graduating in Mechanical and Electrical Engineering in 1894, he prefaced a long and distinguished academic and professional career by this minor teaching post. After an interlude spent on mechanical work in the United States he returned to the staff, and, advancing steadily, became Professor of Mechanical Engineering. In that capacity, he built up a department that enjoys high prestige in the engineering schools of this continent.

By the end of 1894, most departments had found that their needs for equipment were relatively minor in character. The Department of Surveying wished to have a portable transit instrument for practical astronomy, and a small building to house it. The chief requirements of the Department of Architecture were associated with library and lantern slides. The attic, where the slides would be prepared, was still not occupied or equipped. That being the case, there could be no photometric work undertaken on electric lights.

Imminent removal of the University Department of Chemistry to the new Chemical Building afforded an opportunity for the administration of the School to review its space difficulties and remedy shortages and inconveniences that had developed with the years. It was particularly desirable that the assaying and blowpipe laboratories be removed from the basement.

A useful extension service to prospectors and miners in the field

was undertaken in the summer of 1894. W. E. Boustead, Fellow in Assaying and Metallurgy, along with W. A. (later Professor) Parks, held well-attended classes at Sudbury and Rat Portage.

One of the difficulties with which Galbraith had to contend was that of operating the School efficiently under the more or less direct control of a department of government. Incompetent persons, with no other qualifications than political ones, would sometimes be sent over from Queen's Park for employment about the School building and the Principal was supposed to get along as best he could with them. A typical instance is recorded in Galbraith's letter of November 30, 1894, to the Minister of Education:

> In speaking with the man who came on as night fireman yesterday Simpson discovered that he had no experience; knew nothing about steam boilers, didn't know what a steam gauge was, had never burned coal, etc. I told Simpson not to set him at work until I had communicated the state of the case to you.
>
> Such a man would be worse than useless; he would be dangerous. He could not keep up the heavy fires necessary and if an accident occurred he would be helpless. A return might leak and the boilers be burned without his knowing it. He would simply be a source of constant anxiety. We need a man experienced in the working of a steam heating plant.

With the first term of 1895–96 came a most welcome adjustment of accommodation for School classes, made possible by the completion of the Chemical Building. The first-floor room at the northeast corner of the old building, which had been used by Professor Pike as a students' laboratory, was converted into a blowpipe and assay laboratory. The space in the basement immediately below it was equipped with galvanometers, electrometers, and other delicate instruments requiring steady supports. Several small rooms in the basement, when combined into a single room, provided space for a stamp mill, a vanner, a crusher, and other equipment for the treating of gold ores.[21]

A significant teaching adjustment came with the shifting of the quarters for Chemistry. The subject of Elementary Chemistry, formerly taught by the University Professor of Chemistry, was assumed by the Professor of Applied Chemistry on the opening of the session.

Gradually, the requirements for admission were being modified by placing emphasis on the matriculation subjects most indicative of the probable success of the entrant in his academic course and in the

[21] *Ibid.*, 1896, vol. XXVIII, Part 1, no. 2, p. 283.

profession that he would subsequently join. Effective in the autumn of 1895, the matriculation examination for Applied Science students was declared to be adequate without a standing in Greek and Latin.

Early in 1895, the Principal was officially informed that at the last session of the Parliament of Canada changes in the tariff had been made under which free entry of equipment and supplies for the use of the School of Practical Science, or similar schools, would no longer be allowed. Fortunately, the major articles of equipment necessary for the laboratories envisaged at that time had been procured under the exemption granted by the Minister of Customs in 1891 as a result of strong representations made by Galbraith.

In December, 1895, J. A. Duff reported to the Minister of Education certain observations and suggestions respecting the testing of materials and the teaching of Theory of Construction, based on a visit to nine leading laboratories in the United States. He recommended the purchase of three small testing machines and specific improvements in the methods of keeping records and the exhibition and storage of ruptured specimens.[22]

The year 1896 found the mining millroom completely equipped according to plan, but apparatus was still needed for the treating of refractory gold ores and the smelting and refining of other ores. The museum display in mineralogy and geology was satisfactory, but the metallurgical collection was not.[23]

The Department of Mechanical and Electrical Engineering rejoiced in a new switchboard, while a rotary transformer, built specially for the School, provided three- or four-phase alternating current and supplied power to a three-phase induction motor. Suggestive of alertness to new discovery was an expressed desire for Roentgen-ray equipment.

Experience with the rapidly extending work of the fourth year in the laboratories prompted Galbraith to recommend the reinforcement of the permanent staff by the appointment of at least three persons with a grade intermediate between Fellow and Lecturer. So it was that the academic ranks of Demonstrator and Instructor were forecast.

By statute of the Senate enacted on January 31, 1896, it was provided that graduates who had obtained the degree of B.A.Sc., or

[22] *Ibid.*
[23] *Ibid.*, 1897, vol. XXIX, Part 1, no. 1, p. 354.

the diploma before June, 1895, might qualify for the professional degrees of Mining Engineer, Mechanical Engineer, or Electrical Engineer, as well as that of Civil Engineer, which had been available for twelve years.

Ever alert to the need for adjusting the resources of the School to its expanding role in engineering education, Galbraith often felt compelled to make use of inferior space for purposes that were very different from the original ones. Thus, his letter-book record for January 29, 1897, contains a sketch plan and lengthy instructions, both in his own hand, relating to some rather extensive changes that were desired in the basement accommodation. Better space was not available.

Steady progress was maintained through the session 1897–98. James Watson Bain, who had completed the diploma course in Mining Engineering in 1896 and obtained the degree of B.A.Sc. in 1897, was appointed Fellow in Mining Engineering. In 1914 he became the first Professor of Chemical Engineering and five years later the head of the Department. Over many years he continued to give a quality of service to the School and the University that has been justly gauged by the universal esteem for him expressed by staff, students, and graduates.

Small accessions of equipment had facilitated the development and improvement of the work of the School, but vexations about space continued. Existing drafting-room accommodation was all in intensive use. It was proposed that a workroom on the third floor near the tower be fitted up as a drafting room and that a new workroom be provided in the attic, to be accessible by a steep circular staircase in the tower. Thus came into existence this continuing source of student banter.[24]

With the opening term of 1898–99, R. W. Angus became Fellow in Mechanical Engineering, and A. H. Harkness, who was later to attain marked distinction in the consulting field of structural engineering, was appointed Fellow in Civil Engineering.

At last, the attic was coming to its own. A darkroom was provided therein and a firm announcement was made that this usable space would be supplemented by several other new rooms.[25] That was done in the summer of 1899.

[24]*Ibid.*, 1897–98, vol. XXX, Part 1, no. 1, p. 188.
[25]*Ibid.*, 1898–99, vol. XXXI, Part 1, no. 2, p. 292.

As the century drew to a close, steadily increasing enrolment in the School was forcing action for the provision of additional space. At the opening of the session 1899–1900 there were 91 students registered in first year, as compared with 70 the year before. Total registration had risen from 156 to 192. It had to be admitted, though, that 21 per cent of the graduates were in the United States.[26] Industrial employment of engineers in Canada was still low.

Drafting-room accommodation was especially inadequate. The use of the third-floor corridor as an overflow drafting room, intermittently repeated for nearly half a century of recurrent congestion, had begun. Galbraith feared that if the first year should become larger the following year, it would be impossible to find sufficient accommodation in the existing building.

The Department of Applied Chemistry declared its quarters to be quite inadequate for the number of students in attendance, despite the division of the laboratory classes into four groups.

Reporting on the matter of accommodation at the end of 1899, Galbraith could see no solution of the problem short of the construction of a new building in the near future. He proposed that it be erected on the grounds between the School of Practical Science building and College Street. It might be necessary to remove the old Wycliffe College building, then occupied by the Toronto Technical School.[27]

All the work that was being done in the original part of the School building, erected in 1877–78, should, he said, be removed to the new building. This would include Analytical and Applied Chemistry, Mineralogy, Geology, and Mining. The space so vacated was needed for the expansion of the departments that remained in the existing building. The Principal alluded to the possibility of joint action with the University authorities, out of which might come a building that would serve the requirements of the Arts courses in Mineralogy and Geology, as well as those of the School. He hastened to observe that the rooms in the joint building to be occupied by School of Practical Science students should be entirely separate from those occupied by students in Arts. Galbraith did not like joint occupancy. Experience in the old building had intensified his caution.

[26] *Ibid.*, 1900, vol. XXXII, Part 5, no. 12, p. 219.
[27] *Ibid.*

The staff changes for 1899–1900 were comparatively few. J. W. Bain became Demonstrator in Analytical Chemistry, and A. T. Laing, an 1892 graduate in Civil Engineering, was appointed Demonstrator in Surveying. While the latter's initial teaching experience was relatively short, he was to serve the School for many years as Secretary and Registrar, and the succeeding Faculty of Applied Science and Engineering as Secretary.

The Principal's concern about inadequate accommodation was augmented with the opening of the 1900–1 session. The freshman class was up 21 per cent and the total enrolment 18 per cent. Part of the assembly hall on the third floor had to be fitted up as a drafting room and the remainder as a lecture room. The laboratory work in Chemistry was being carried on in quarters designed for classes one-third the size of those actually using them. Subdivision of classes was necessary, although whole classes could have been taught in larger rooms and at less expense. The chemical laboratories were entirely out of date, being in rooms intended for quite different purposes. Ventilation was abominable.[28]

Galbraith repeated his urgings of the year before for a new building. He added a further proposal that thought be given to providing in it for a Provincial Museum of Geology, Mineralogy, Mining, and Applied Chemistry.

Meanwhile, the Principal was having his difficulties with Queen's Park. On October 9, 1900, he protested to the Department of Public Works that the coal supplied for experimental work in engine testing was entirely unsuitable:

> Our first engine test was made on Thursday and Friday last and the greater part of the results was rendered useless from the fact that it was found impossible to maintain a constant steam pressure during the day's work. Failure in the actual test involved loss of a week's time to the students engaged in it, and as the session is crowded with work it is impossible to repeat a test which has failed.

Two days later, in reply to the urgings of the Department of Education to keep down expenses as much as possible, he had to say that he feared very little could be done about it. "The attendance this term is the largest on record, so that in spite of all endeavours to the contrary the probability is that the expenses will be greater than ever."

[28]*Ibid.*, 1901, vol. XXXIII, Part 4, no. 12, p. 199.

A significant organizational development, foreshadowing a still more important one a few years later, came in the last few days of the century. By statute passed on December 14, 1900, subsequently approved by the Lieutenant-Governor in Council, the University Senate declared that the teaching staff and examiners of the School of Practical Science, together with the examiners for the degree of B.A.Sc. and the professional degrees in Engineering, constituted *ex officio* the Faculty of Applied Science and Engineering of the University of Toronto. The courses and examinations of the School of Practical Science leading to diplomas, special certificates, or degrees were to be the curriculum and examinations of the University in the new Faculty. Further, the members of the teaching staff, examiners, and students of the School were accorded the status of staff, examiners, and students of the University. By this device the University acquired a new Faculty without assuming any liability for its support or maintenance. The compound of union and separateness was to prove a source of difficulty a few years later.

Notable tributes to the contribution which the School had made to technological education, and particularly to the able and devoted services that had been given by Galbraith in the twenty-two years that had elapsed since his appointment, were paid at a large banquet at McConkey's on December 21, 1900. On that occasion the Principal gave an outstanding address, in which he outlined the function of a school of applied science in the education of the engineer.[29] The philosophy of education which he had enunciated in 1892[30] was reaffirmed and supplemented.

A valuable service in the ceaseless campaign to secure better accommodation and facilities for the School was performed through the presentation by deputation of a petition signed by all the students in attendance to the Lieutenant-Governor in Council on March 6, 1901. This document complained of overcrowding, bad lighting, poor ventilation, inadequate library and laboratory equipment, a staff only half as large as it should be, lack of an assembly hall, and the like. Such action on the part of the student body must have had considerable effect in bringing a governmental decision to proceed with the construction of the Mining Building.

[29]John Galbraith, "The Function of the School of Applied Science in the Education of the Engineer," *University of Toronto Monthly*, vol. I, no. 5 (1901).
[30]Galbraith, *Technical Education*.

Another session came, and with it a further burst of registration. The autumn of 1901 saw first-year enrolment up by 32 per cent, and the total enrolment of 290 up by 28 per cent over the previous year. Graduates were finding work without much difficulty, although 22 per cent of them had left, either temporarily or permanently, for the United States.[31]

Once again, came the plaint of overcrowding from the Principal. All seats had been removed from the assembly hall and it had now become a drafting room. The prospect for space for the next year appeared dismal. The deplorable situation in the chemical laboratories had been intensified by the ever mounting attendance. No important development could be undertaken in Mineralogy and Mining Engineering until better quarters were available. The Department of Electrical Engineering was in need of more laboratory space.

Heartening events indicative of future development occurred during the summer of 1901. There was the tour of Principal Galbraith and Professor C. H. C. Wright to engineering schools in the United States to gain familiarity with the best in engineering buildings, so that the structure later to be known as the Mining Building would be as efficient and convenient as it could be made. They visited the Michigan College of Mines, Houghton; University of Wisconsin, Madison; Armour Institute of Technology, Chicago; Case School of Applied Science, Cleveland; and the Rose Polytechnic Institute, Terre Haute, Indiana. Subsequently, Galbraith, along with F. R. Heakes, the Provincial Architect, inspected the buildings of the Massachusetts Institute of Technology, Columbia University, Cornell, Harvard, Stevens Institute of Technology, University of Pennsylvania, and McGill. J. W. Bain visited a number of the English and continental Schools of Applied Science.

By the end of 1901 the plans for the new building were well under way. The Principal had asked that the space provided should be adequate for at least ten years. It had been decided that the milling laboratory would be housed in a separate building in the rear of the main one.

The necessity for working with two government departments in a parsimonious atmosphere made it difficult to secure the type of building needed. Adequate ventilation was a point on which Gal-

[31]O.S.P., 1902, vol. XXXIV, Part 4, no. 12, p. 206.

braith had to take a firm stand. On April 4, 1902, he wrote to the Minister of Education as follows:

> I have just heard that the contract for the construction of the Chemical and Mining Building is to be let in a few days and yet the plans show no provision for ventilation.
>
> One of the first requirements of a modern building containing chemical laboratories and lecture rooms is efficient ventilation and apparently the new building is to be no improvement on the present one in this respect, and without the same excuse. At the time our present building was erected the problem of the satisfactory ventilation of laboratories had not been solved. The case is quite different now; we shall lay ourselves open to the well deserved criticism of those who know if steps be not immediately taken to remedy this neglect. The good name of the building in the scientific world will depend very largely on the scheme of ventilation adopted.
>
> Our expert in the work should be employed in the Architect's Office for it should not be handed over to the ordinary staff. The problem is really an engineering one demanding special knowledge and experience.
>
> I consider it impracticable to introduce an efficient system of ventilation after the contracts for the walls, floors, and roof had been let. This may probably be done in heating and lighting but not in the case of modern ventilation.
>
> The details of the ventilation should be shown on the plans before the contract is let.

The session 1902–3 began with a total enrolment 17 per cent higher than in the previous session, although the number of students in the first year was slightly down.[32] This increasing pressure of numbers made it necessary to utilize one of the lecture rooms as a drafting room, and to take over a section of the museum for lecture purposes. In consequence, part of the collection had to go to the basement. Other branches of work were experiencing similar difficulties and inefficiencies.

At last, towards the end of 1902, the Chemistry and Mining Building, as it was then called, had been commenced, and there were hopes of having space in it by the next session. Construction of the Milling Building should be begun by the spring of 1903, observed Galbraith, in order to allow for installation of equipment. A preliminary step would be the removal of the old Wycliffe College building.[33]

Some restriction in the members of the staff who might sit on the Faculty Council was imposed by an Order in Council dated January

[32] *Ibid.*, 1903, vol. XXXV, Part 4, no. 12, p. 198.
[33] *Ibid.*

30, 1903. Thereafter, Council consisted merely of the Principal, the Professors and Lecturers, and the Registrar.

Galbraith continued to urge, with all the energy at his command, the establishment of a just salary scale for the staff of the School. Commenting on the text of a proposed Order in Council he wrote to the Honourable Richard Harcourt, Minister of Education, on January 28, 1903:

> The limits proposed will, in my opinion, inflict a grave injury on the efficiency of the School. It will be considered by the staff of the School to be unjust that the Government should propose a schedule of salaries at this period in our history distinctly inferior to that adopted in the Faculty of Arts. . . . The question as to the position of any particular member of the staff in the scale is largely an individual one. The question of the schedule itself is a matter of provincial importance. The adoption of the proposed schedule would distinctly stamp higher technical education in the Province of Ontario as being of less importance and of lower grade than that of the Faculty of Arts. This idea, while once prevalent, has now disappeared in the United States, England, and the Continent, and in these countries the scientific training of engineers and manufacturers is in the hands of teachers fully the equal in social standing and emoluments of those in the Universities in the older faculties. I sincerely hope that the Government will fully consider the gravity of the step which they propose to take in the matter.

Considerations bearing on the relation of costs to rising student population at the School prompted Galbraith to present a statistical analysis of the matter in his report for the year 1903. The average maintenance expenditure, excluding interest, depreciation, and insurance, for the sessions 1890–91 to 1899–1900 inclusive was $132 per student; the teachers' salaries amounted to $107 per student; and the total to $239. For the session 1902–3 the corresponding amounts were, $55, $72, and $127. The following year 60 per cent of the teaching staff were paid on the average $600 each, and the average for the whole staff was about $1,000.

In the opinion of Galbraith, the degree of economy revealed by these figures was unexampled in the history of technical education. He added that they might well be used to cast doubts on the efficiency of the School were it not for the overwhelming evidences of the contrary afforded by the list of graduates and their positions published in the annual Calendar. There was no doubt, however, that economy had been carried to a dangerous point and that there ought to be a change of policy in this respect.[34]

[34] *Ibid.*, 1904, vol. XXXVI, Part 5, no. 12, p. 209.

Overcrowding had, of course, continued and pressure was maintained on the Government to complete the Chemistry and Mining Building by October, 1904. At the same time, seven additional persons were required for the staff.

During the summer of 1903 a situation arose concerning the teaching of Physics to School of Practical Science classes which was to provoke stormy exchanges within the University and between the University and the Provincial Government. Up to that time, instruction of engineering students in the subject had been given by the staff of the University Department of Physics, and not by any member of the staff of the School of Practical Science. A change in that arrangement was now requested by the School.

There had been, and still are, differences of opinion in the professional schools of engineering as to whether Physics should be taught in such institutions from the point of view of the pure scientist or that of the engineer. James Loudon, writing to the *Globe* in 1874, had said that for an independent school of engineering there were strong reasons why such auxiliary subjects as Mathematics, Natural Philosophy, Chemistry, Mineralogy, and Geology should not be taught by University College. An adequate treatment could be given by applied science professors.[35] That view was essentially reiterated in his report of 1875 on a plan of reorganization of the downtown School of Practical Science.[36]

John Galbraith, coming on the scene later from the field, was of the same opinion. He believed that the needs of the engineering students of that day could be best met by having the work definitely oriented in the direction of practical application. In his view, the establishment of a Department of Applied Chemistry in the School had been advantageous. But with respect to instruction in Physics, he was prepared, for the time being, to accept a substitute arrangement. In May, 1903, he asked President Loudon, who had retained the chair of Physics, to have a special lecturer appointed in the Department of Physics in the Faculty of Arts whose duty it would be to teach Physics to engineers separately. That was not done. There are grounds for believing that the reason lay in the impending transfer of the active control of the Department to one to whom that step would not have been acceptable.

[35]*Globe*, January 17, 1874.
[36]W. H. Ellis, Supplementary Report, O.S.P., 1875–76, vol. VIII, Part 3, no. 27.

On his appointment as President of the University in 1892, James Loudon's relation to the Department of Physics became, of necessity, merely that of titular head. The exactions of the presidential office precluded close attention to the affairs of any single department. Gradually, he came to rely more and more heavily on Dr. J. C. (later Sir John) McLennan, then Associate Professor of Physics. McLennan was able, energetic, ambitious, politically minded, and an organizer of remarkable talent. By 1903 it was generally believed in University circles that he was about to be named Director of the Physical Laboratory. The rumours were well founded. Next year, the appointment was made. Actually, he had already served in this capacity for ten years and in that role had exercised very considerable power. But with a substantive appointment he would have complete control and direction of all laboratory work in Physics and the teaching relating thereto.

Galbraith and the members of his staff were apprehensive. They believed that the difficulties of arranging for the type of work in Physics that they held to be desirable for engineers at that time would be greatly increased, or even insurmountable. McLennan had acquired a reputation of carrying everything by storm and attaining his objectives at any cost. As Secretary of the University of Toronto Alumni Association, he had dynamically furthered its enterprises, such as the erection of a separate building for Physics and the provision of a capacious Convocation Hall, but his methods were sometimes such as to arouse resentment. This had been the case on more than one occasion in interviews with Premier George W. Ross.[37] There were, too, persistent rumours of the existence of the unhappy relations within the Department of Physics that were revealed in the investigation of the Jamieson charges of 1904–5.[38]

The matter rested for the session of 1903–4. On its conclusion, the Honourable Richard Harcourt, Minister of Education, received an application from George R. Anderson for a position on the teaching staff of the School of Practical Science, to take charge of

[37]H. H. Langton, *Sir John Cunningham McLennan: A Memoir* (Toronto, 1939).

[38]In a series of articles in a downtown periodical C. R. Jamieson, the editor of the *Varsity*, had charged the administration of President Loudon with incompetency and favouritism, which had impaired the morale of the University. A Royal Commission, after taking evidence at length, reported in 1905 that, while irregularities had occurred, the fault lay primarily in the overload of the President and those shortcomings of the University organization that were to be remedied in the University Act of 1906.

the instruction in Physics. Anderson was familiar with the work, having served as an Assistant in Physics for the period 1899–1903 in the Faculty of Arts. In the session 1902–3 he had charge of the greater part of the work for School of Practical Science students.

This extraordinary procedure of making application directly to the Minister was characteristic of the educational practice of the time at the university level. Whatever the Acts of the Legislature applicable to the University or to the School of Practical Science might or might not say about appointments, the ministries jealously retained their patronage. Applicants consequently addressed the Minister in the first instance, and he, if he cared to do so, might consult the Principal, or the President of the University, of which the School of Practical Science constituted the Faculty of Applied Science and Engineering by a Statute of the University Senate of 1900, confirmed by the University Act of 1901 (Statutes of Ontario, 1901, c. 41).

On May 27, 1904, the Minister wrote to Principal Galbraith respecting Anderson's application, and on June 1 concerning the proposed transfer of the instruction of engineering students in Physics from the Faculty of Arts to the School of Practical Science staff. In the latter communication Harcourt asked about space requirements, the efficiency and economy of the proposed change, and the necessary expenses in connection with appointments and equipment.

Galbraith replied on June 4 that space could be found at small expense. He thought the change would increase the efficiency of the instruction not only in Physics, but in other subjects, on account of the additional freedom in time-table arrangements. There would be better opportunities than then existed for modifying the teaching of Physics to suit the changing requirements of engineering education. The School was then large enough, Galbraith said, to employ fully the services of one instructor and perhaps two. There would consequently be no less economy with the proposed change. For equipment, $1,000 would serve at the start, with possibly an additional $1,000 the next year. The subjects to be transferred would be Heat, Light, Sound, Electricity and Magnetism, and Hydrostatics. The Principal concluded by saying that he would be glad to support Anderson's appointment as Lecturer in Physics on the School of Practical Science staff. Galbraith's phraseology indicates that he

recognized, as he had to do many times before, that the Minister was in the saddle in matters of employment. Harcourt was evidently satisfied with Galbraith's report, for at the University Alumni banquet of June 10, 1904, he referred approvingly to it.

President Loudon was incensed. He immediately wrote to the Minister demanding copies of all correspondence bearing on the matter, saying that he got his first definite intimation of any objection to the arrangements of the University authorities regarding the teaching of Physics from the Minister's speech. He reminded Harcourt that under the amended University Act the duty of recommending appointments rested on him as President, although he would consult the Principal (S.O., 1904, c. 35, s. 4).

On June 28, the Minister replied stating that the matter would be deferred, and a few days later in an interview with Harcourt, in the presence of the Attorney-General, the Honourable J. M. Gibson, as acting Premier, Loudon received the further assurance that nothing would be done until the whole question could be discussed with the Premier after his return.

A significant commentary on the attitude of the Minister to appointments is contained in his letter of June 30 to President Loudon, wherein he remarks that "the intimation that you should be consulted as to appointments to the staff of the School of Practical Science surprises me."

Somewhat later, Loudon called on Attorney-General Gibson, still acting Premier, who called in Harcourt. On Gibson's observing that Loudon was right in his interpretation of his prerogatives as President, Harcourt remarked that "it was all Ross's doing."

The confusion of unofficial announcement and contradiction was finally resolved when, on August 29, a deputation consisting of the Chairman of the Board of Trustees, the Vice-Chancellor, and the President waited on Premier Ross. While the Premier was not prepared for the discussion, it was arranged that a conference should take place at a date to be fixed. He did go so far as to say, however, that Anderson had been appointed and that it had been decided that a separation of the work in Physics should be put into effect.[39]

President Loudon then took steps to inform the University about the course of events. He had a long letter to the Minister printed, under date of September 13, 1904, and attached to it a printed copy

[39]James Loudon, unpublished memoirs.

of Principal Galbraith's letter of June 4 to Harcourt. Copies were furnished to the Senate, the University Council, and the Heads of the Colleges.

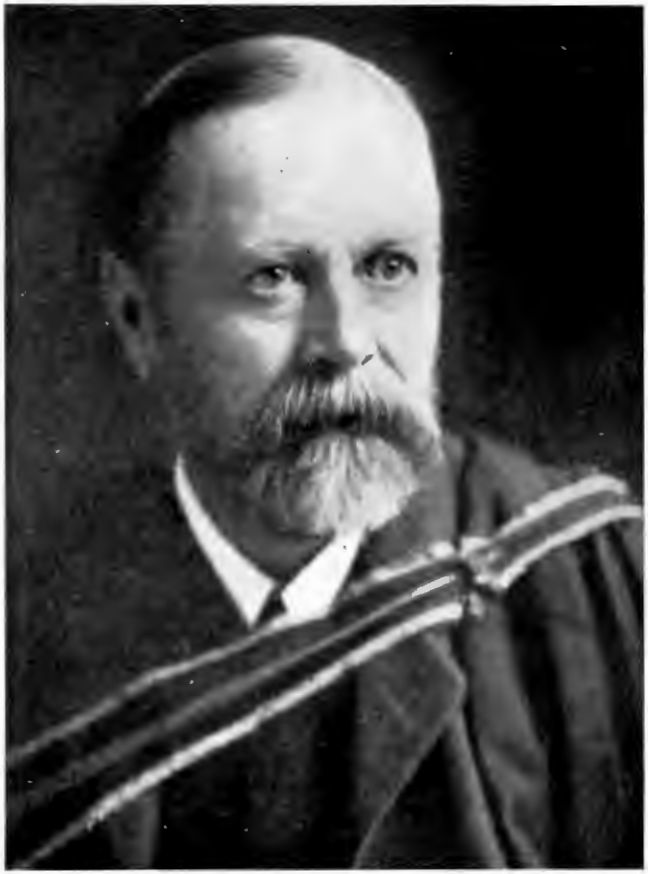
In his letter, the President took issue strongly with Principal Galbraith, stating that the proposal, if carried out, would prove most prejudicial to the engineering students and bring discredit upon the Faculty of Applied Science and Engineering. He expressed the view that the staff and equipment to be employed would be inadequate for proper university teaching. The School would be placed in a position of damaging contrast with institutions like McGill, where students of engineering were enjoying all the facilities of a Department of Physics comparable with those at Toronto in staff and equipment, and with superior building accommodation. He contended that there would be an economic loss, in that the Arts staff required for students in Arts and Medicine would also be sufficient for engineering students at a merely nominal increased expenditure. With the withdrawal of engineering students for certain periods of the week, the laboratories of the Arts department would be vacant, the equipment unused, and a part of the staff unemployed. At the same time, the expenditure for staff and equipment for Physics in the School would be likely to increase greatly from year to year and an extravagant duplication would occur. Loudon saw no reason why time-table difficulties could not be met.

The President complained of the action of the Government in appointing Anderson without a previous report from himself. The amendments made to the Act (S.O., 1904, c. 35, s. 4) in the last session of the Legislature were applicable to appointments in the School of Practical Science. Since 1900, the School had constituted the Faculty of Applied Science and Engineering of the University and as such formed an integral part of the University, as did the Faculties of Arts and Medicine.

There then occurred one of the most remarkable events in the history of the University. From what source came the inspiration for it does not appear in the record. On September 15, 1904, a protest in the matter of the Physics transfer was lodged with Premier Ross by Chancellor Burwash of Victoria University, Provost Macklem of Trinity College, Dean Reeve of the Faculty of Medicine, and Dean Willmott of the Royal College of Dental Surgeons. The group stated that they had seen in a city paper a few days before that

William Hodgson Ellis at a lecture, about 1900.

John Galbraith at a lecture, about 1900.



William Hodgson Ellis, about 1908.

John Galbraith, about 1903.

Physics for the Faculty of Applied Science and Engineering was to be separated from the Department of Physics in the University, and for this purpose a new appointment had been made. They had seen a copy of a letter to the Minister of Education (evidently Galbraith's letter of June 4) advising that such change was in the interest of students in engineering. They pressed the following considerations on the Premier:

(1) The change would be detrimental to the Faculty of Applied Science and Engineering; they would deprecate it for their own Faculties or allied colleges.
(2) It would threaten postponement of improved provision for the work of the Department of Physics, which they regarded as essential.
(3) A policy of division would involve expense far beyond what is necessary to furnish the best provision for a common laboratory.
(4) Physics lays foundation for other sciences and hence adequate provision for it is essential.

It would appear that the Premier and his Minister of Education were not alarmed at these representations. On September 23, Harcourt wrote to Loudon:

I beg to acknowledge receipt of your letter of September 13th. Principal Galbraith's work in connection with the School of Practical Science, whether as regards teaching or administration, has been admirably successful. This being admittedly the case, I could not be expected to treat lightly his recommendations. It is to be regretted that you and he are at variance as to the matter under consideration. I will, at an early date consult with Principal Galbraith.

Whether such consultation took place is not revealed in the records. In any event, the Minister did not recede from his position in support of Galbraith's recommendation.

In the meantime events had been moving rapidly in the direction of an inquiry into the whole question of appointments, tenure, and efficiency of the teaching staff. During the spring months of 1904, the *Globe*, in a series of editorials, had been demanding remedial action. As a result of what President Loudon termed in his memoirs "the slanderous attack of the *Globe*," the Senate of the University, on June 8, 1904, resolved that the President be requested to inquire into the conduct, teaching, and efficiency of every professor and instructor in the University, as to the general condition and progress of the University and report thereon with all convenience and

speed, and that the Principal of University College be requested to make a like inquiry respecting that College.

The task was both invidious and futile. Writing to the Minister of Education on another occasion Loudon had observed, "Power of inquiry into the teaching and efficiency of the staff is by the Act vested, not in the President, but in the Senate—a most improper body for this purpose."[40] It was for this reason that Galbraith had declined to join the President in the preparation of a report to the Senate.

At a meeting of the University Senate held on October 14, 1904, President Loudon's letter of September 13 to the Minister of Education respecting the controversial appointment in Physics was presented and taken as read. A Committee to consider and report on its contents was named by Sir Charles Moss, the Vice-Chancellor. It consisted of Chancellor Sir William Meredith, President Loudon, Dr. John Hoskin (Chairman of the Board of Trustees), the Vice-Chancellor, and Chancellor Burwash.

The Chancellor, who acted as Chairman, reported progress at the November meeting of the Senate and suggested that the Committee be reappointed. There is no record of its ever having reported. The matter seems to have been submerged in larger and more comprehensive investigations of University affairs.

Meanwhile the President proceeded with the general investigation which the Senate, on June 8, had requested him to make. His report, presented on February 10, 1905, was referred to a Committee consisting of the Chancellor, the Vice-Chancellor, and the Heads of the federated Universities and Colleges to report thereon at an early date. That Committee requested the Senate, on March 10, to appoint a special committee "to examine the whole question of the relations of the School of Practical Science to the University and the Senate and to make such recommendations as they may deem advisable." The Senate concurred, and named to the Special Committee the Chancellor, the Vice-Chancellor, the President, Principal Galbraith, the Heads of the federated Universities and Colleges, Mr. Riddell, Mr. King, Mr. Patterson, and Mr. Worrell. This Committee, like the one on the Loudon letter of September 13, 1904, never reported. It was lost in the turmoil of the Jamieson charges and their investigation.

[40]Langton, *James Loudon.*

But Loudon neglected no opportunity to point out to Queen's Park the shortcomings of the educational administrative system as it existed in practice. Following the defeat of the Ross government, he addressed a long letter to the new Minister of Education, Dr. R. A. Pyne, in which he recounted in detail the events associated with the transfer of the teaching of Physics to the School of Practical Science staff.[41] To what he had previously put on record he added that, following the recognition of the School as the Faculty of Applied Science and Engineering in 1900, he was requested by Richard Harcourt, the former Minister, to include it in his annual report and thereafter had continued to do so. Since then, Galbraith and other professors in the School of Practical Science had been recognized as members of the University Council on the same footing as the professors in the Faculties of Arts and Medicine. As President, he had also been requested to report to the Minister on the reorganization of the Departments of Mineralogy, Geology, Mining, and Metallurgy, and had done so in 1902.

Loudon stated further that the 1904 amendment to the Act had been completely ignored so far as the Anderson appointment and subsequent ones to the staff of the School of Practical Science were concerned. His protest as to the illegality of Anderson's employment was met by a declaration from Premier Ross that the amendment could be repealed. It had not been repealed, however, and Loudon urged that Anderson was not legally entitled to the position in the University "to which he was appointed without my knowledge, and in which he has been retained contrary to my representations."[42]

Long afterwards, in the *University of Toronto Monthly* for May, 1912, President Loudon commented on the matter of appointments in the University:

> One of the difficulties I had to contend with, in common with my predecessor, Sir Daniel Wilson, was the question of appointments. Except in the case of minor positions on the staff, the Government steadily persisted in the practice of ignoring the President, and making appointments without necessarily consulting him. In my time the theory, as once stated to me by the Minister of Education, was that the Government should provide the professors, and the duty of the President was to make the best he could of the materials so supplied.

The weakness of the appointment system was that while the amendment of 1904 included in the presidential duties the power of

[41]Loudon, memoirs.
[42]*Ibid.*

appointments or promotions on the Faculties, the Act "did not say that the Government must accept or even seriously consider the President's recommendations . . . and they did not."[43]

Despite the administrative tenseness at high levels that characterized the year 1904, the autumn term opened quietly at the School of Practical Science. The authorization of a sixth graduating course—Chemical Engineering—had been given in the spring and the work of building up what was to become a great department of study and research began with enthusiasm.

With the opening of the session there came to the staff one of the finest teachers and most likeable of men—Peter Gillespie. His first academic post was that of Demonstrator in Applied Mechanics. In the course of the years he became the first Professor of Civil Engineering in the Faculty. Unfortunately, he was cut down in 1929 at the height of his remarkable powers. No member of the staff is remembered with greater affection by colleagues and graduates of his time.

During the 1904–5 session students of the first and second years were informed that theses would no longer be required on entering the second and third years. Graduates of that period will recall the hilarity with which the announcement was received.

Already plans were in the making for the redistribution of space in the Engineering Building in anticipation of early occupancy of the Chemistry and Mining Building. The old assembly hall was to be set apart for drawing. Dr. Ellis's private room was to be turned over to Mr. Anderson and the "poison room" of the genial doctor was to be given to Mr. McGowan. It ought to be said that the room bearing the sinister designation was that in which Ellis, as Provincial Analyst, investigated cases of suspected poisoning for the law officers of the Crown.

Occupation of the structure which was later to be known as the Mining Building came in the early part of 1905. Plans had been laid for a formal opening, but the Principal reported that it was impossible for the Government to provide any funds for the event. As the construction of the museum wing at the east end had not yet been commenced, it was necessary temporarily to place the geological and mineralogical collections in rooms required for other purposes. This portion of the building had been delayed pending

[43]Langton, *James Loudon.*

the consideration of a larger scheme involving the erection of a general museum to include sections devoted to Archaeology, Ethnology, etc.

The space in the old Engineering Building vacated by the removal of certain teaching departments to the Mining Building was not at all suitable for the expansion of those that remained. Laboratory space arranged sixteen years earlier was now in many respects ill adapted to existing conditions. New equipment, added from time to time, had been installed in whatever room could be found for it. As a result, inconvenience and difficulty in the use of the apparatus were experienced, a circumstance which could not fail to produce an unfavourable impression on the mind of a visitor. Such had been one outcome of the rapid growth and increasing popularity of the School. The laboratories had been designed for a total student population of 150, whereas at the opening of the session of 1904–5 the attendance was 484.[44]

Galbraith and his staff felt that the only remedy for this was a third building. It should, they thought, be placed between the two existing ones and not encroach upon either. None of the space vacated in the Engineering Building could be used for expansion in Hydraulics or Thermodynamics, because of the great weight of the necessary equipment and the large amount of floor space required. The same was true of experimental work in Mechanics of Materials. A second experimental boiler was urgently required, but could not be installed to advantage in the Engineering Building.

By the first term of 1905–6 the enrolment had mounted to 538. The staff was still overworked and underpaid. Galbraith once again reported to the Minister that the number of instructors in the higher grades should be increased and that they should not be paid less than was paid in the Faculty of Arts.[45]

Returning students were astonished to find that a new building had suddenly appeared in the area immediately to the south of the Engineering Building. It was a small wooden observatory erected for the use of fourth-year students specializing in Astronomy and Geodesy. As shown in the illustration facing page 86, it was on the site now occupied by the Mechanical Building.

While work was carried on in the Mining Building throughout

[44]O.S.P., 1905, vol. XXXVII, Part 4, no. 12, p. 260.
[45]*Ibid.*, 1906, vol. XXXVIII, Part 4, no. 12, p. 312.

this session, the ventilation system was not yet in working order and the equipment in the milling laboratory was still not fully installed.

In a school of engineering, populated by large numbers of vigorous and assertive young men, it would have been strange if problems of discipline did not arise. From time to time incidents did occur in the School which had been satisfactorily resolved largely through the considerate but firm action of the Principal.

Towards the end of November, 1905, certain disorderly conduct on the part of the second year impelled Galbraith to suspend five students, pending an investigation of the trouble. The first year, in support of the second, absented themselves from work.

Council, on consideration of a memorandum submitted by the second year, decided to leave the matter to be dealt with by the Principal. It proposed that the men of the year be required individually to sign a guarantee of future good conduct. A large majority of them signed it immediately and work was resumed. The first year withdrew its threat to the University Discipline Committee to remain away from lectures until the suspended students were reinstated.

The passage of the years had led Galbraith to view such incidents philosophically. He grew to take less seriously the outbursts of high-spirited students. He held that if undergraduates insisted on having their fling, necessitating disciplinary measures, then they should in the natural course of events take such discipline without a murmur and pay the price. This they did, confident in the honesty and fairness of the Principal.

Dr. T. Kennard Thomson, whose admiration of the Principal was unbounded, once recalled an occasion on which Galbraith had neatly disposed of a tenseness that had arisen out of a conflict of views between staff and students. At a student banquet, the Principal frankly discussed the situation and gave the reasons for the staff's attitude. He then told of an Irishman's attempt to ride a mule that tried in every conceivable manner to get rid of the rider. Finally, when one of the animal's hind feet caught in a stirrup, the son of Erin met the situation with the comment, "Begorra, if you are going to get up, I think I had better get off." Galbraith added that, in the matter in question, the Faculty was not going to get off. Somewhere in the vociferous applause that ensued, the friction vanished.

During the last weeks of 1905 much attention was given by the Council of the School to the preparation of a submission to the Royal Commission on the University of Toronto, which had been named on October 3. Public unrest following the Jamieson charges and their investigation, evident in the press and the representations of the Alumni Association of the University, had convinced the Government of the need for a basic inquiry into the organization, problems, and needs of the institution.

Although Galbraith had placed his personal views before the Commission on November 8, it was necessary to prepare a formal submission on behalf of the Council. As finally approved on January 6, 1906, the proposals advanced respecting the School of Practical Science were:

(1) The composition and functions of the Council should be preserved.
(2) If finances are to be transferred to the governing body of the University, the School should have equal representation on that board with the other bodies and colleges concerned.
(3) Appointments and dismissals should be made by the governing body after a report from the Principal of the School.
(4) Records of estimates and finances of the School should be kept separate and distinct from the records of similar matters relating to other parts of the University.
(5) The scale of remuneration for staff and employees should be not lower than that in Arts.
(6) In making provision for retiring allowances a sum should be placed to the credit of each staff member representing a fair equivalent of what he had been entitled to as a civil servant at the date of transfer.
(7) The number of the staff should be increased so that the student-staff ratio be not greater than 8 or 10 [it was then 16].
(8) New buildings should be provided for the subjects then accommodated in the Engineering Building.
(9) As soon as staff, buildings, and equipment permit, the three-year course should be extended to four years.

Appended to these specific suggestions were certain general observations of the Council which could not but be of assistance to the Commission. They were based on long experience in operating a professional school under grave difficulties. The more important of them were essentially as follows:

(*a*) Members of the staff are wholly absorbed in instructional work and have no time for the original investigation necessary to make the School a scientific centre. In cases of sickness the staff must either

leave students without instruction or greatly overload those who carry the burden.

(*b*) Lectures should not be given to more than 50 or 100 students at a time. A large staff and small lecture rooms is better than a small staff and large rooms. A larger staff is also needed for the practical work.

(*c*) The increasing volume of work for an adequate curriculum necessitates the lengthening of the graduating courses to four years.

(*d*) Increased numbers have made it possible to utilize the whole time of instructors and the whole equipment of laboratories in subjects formerly taught by the Faculty of Arts, for example, Chemistry and Physics. The transfer from Arts has resulted in increased efficiency, not only through greater elasticity of the time-table, but also because of changes in methods and topics of instruction.

(*e*) More buildings are needed. The old Engineering Building is filled to the utmost capacity and is quite unsuitable for the necessary large additions of equipment and extensions of the work. Rather than add one new Engineering Building, there should be several smaller buildings of greater combined capacity. Noise, vibration, steam, and dirt are prejudicial to certain kinds of work exposed to them.

(*f*) The problem of finding space for new buildings must be solved without unnecessary delay. It is not improbable that the student attendance would reach 1,000 within a few years.

While concurring in the memorandum of the Council to the Commission, Professor C. H. C. Wright submitted one of his own dealing with the various new buildings that were considered necessary and with the more controversial question of their location. He was strongly of the opinion that the available space on the University grounds was inadequate to meet the needs of the future for all Faculties. He held that a large tract of land should be secured as near the city limits as possible and the Faculty of Applied Science and Engineering moved there immediately. This could be accomplished under existing conditions without any loss in buildings, but if further structures were erected their design and arrangement would be such as to render them almost useless for any other purpose.

Reporting on operations for the calendar year 1905, Galbraith, with characteristic persistence, returned to the question of future accommodation. In the previous ten years the attendance had increased fivefold, and in the past four it had doubled. Extension of the work in each department indicated the approaching necessity of lengthening the graduating courses to four years. An effect of this would be to force the majority of third-year men to return for their

fourth year. With existing building accommodation it would be impossible to carry on a four-year course.[46]

For these reasons, Galbraith pointed out, new buildings ought to be provided without delay. In order to avoid nuisance from steam, heat, noise, vibration, and dirt, detached buildings were needed for certain classes of work. All of them should be closely grouped and be heated and lighted from a central station. New buildings were required for six distinct purposes:

(1) Electrical Engineering;
(2) Thermodynamics and Hydraulics;
(3) Central Station;
(4) Strength of Materials, Machine Shop;
(5) Cement, Brick, Stone, etc., Tests;
(6) Surveying, Architecture, Drawing, etc.

The Principal urged that the first three structures be erected with as little delay as possible. This done, the site of the existing Engineering Building could be utilized for part of the space required for buildings (4), (5), and (6).

With a view to strengthening the work in Architecture, Professor Wright, in the early summer of 1906, visited five institutions conducting similar courses in the United States. These were Cornell, Pennsylvania, Columbia, and Harvard Universities, and the Massachusetts Institute of Technology. On the basis of the information obtained, Galbraith recommended the appointment before October of a Lecturer in the History and Principles of Architecture.

With the completion of the 1905–6 session there came to an official end an institution which in its 28 years of vigorous life had established a secure and honoured place in professional engineering education and, through its graduates, had contributed immeasureably to the technological progress of this country and lands beyond. Although, as a name, the School of Practical Science ceased to be applicable half a century ago, the great tradition associated with it remained. So firmly is it entrenched that engineering graduates of Toronto, whatever their graduating years may be, still proudly proclaim themselves "School men."

[46] *Ibid.*

6

A NEW STATUS, 1906-1914

TRANSFORMATION of the School of Practical Science into a full-fledged Faculty of the University of Toronto, with the benefits, prerogatives, and restrictions pertaining thereto, was to have been expected in the light of events that led up to the appointment of the Royal Commission on the University of Toronto in 1905. Moreover, the terms of reference expressly directed the Commissioners to enquire into and report upon "the advisability of the incorporation of the School of Practical Science with the University of Toronto."

Some of the most difficult problems confronting the Commission had arisen from the triangular relationship that existed between the School, the University, and the Provincial Government. Their nature was very clearly set out in the Commission's report, as is evident from the following excerpts:[1]

> The nature of the tie between the School of Practical Science and the University has long been one of the anomalies of the administrative system. The form in which their relations were cast by successive Acts of the Legislature, and by Orders in Council, has been, we are convinced, injurious to both institutions.
>
> On the one hand, the School has been separately controlled and managed, and supported by a separate vote of money in the Legislature. This removed it, as far as possible, from its rightful share in the prestige of the Provincial University. Encouraged by a false show of independence, it has been at the mercy of the financial exigencies of successive ministries. The Department of Education, directly responsible for its financial and academic progress, has been attempting to do for one part of the University what, in logic and consistency, it ought to have been doing for all. This exceptional treatment has not justified itself. The Principal and professors, displaying marked zeal and diligence in their executive and teaching duties, have been underpaid and overworked. The School has made wonderful progress on insufficient funds. The students, who include so many of the alert and active minds of the Province, have scarcely felt themselves a part of the University body.
>
> On the other hand, the University has suffered from the inclusion of a

[1]Province of Ontario, Royal Commission on the University of Toronto, *Report*, 1906.

Faculty subject in no adequate sense to its general control and discipline. The University, having no control over its Science Faculty, has been deprived of a powerful lever in appealing for national support. The executive functions of the University have been weakened, and the problem of student discipline has not been rendered easier.

To that portion of the Commission's reference advising "the incorporation of the School of Practical Science with the University of Toronto," the answer was affirmative. It was the Commission's view that closer relations would be of advantage to both. The Provincial system of education should, it held, take into account all the educational requirements of the country. The scope of usefulness for the Faculty of Applied Science and Engineering was widening. It would be a mistake for the Province to turn a deaf ear to the need of greater support for this class of training.

In accordance with the University Act, 1906 (Statutes of Ontario, 1906, c. 55), which was based on the report of the Commission, the School of Practical Science became the Faculty of Applied Science and Engineering of the University of Toronto on June 15, 1906. The Principal of the School became Dean of the Faculty and other members of the staff were declared to hold and occupy the like positions in it that they had held in the School. From the first meeting of the new Faculty Council, held on September 24, the academic machine moved smoothly and efficiently into action.

Early in the session Professor Louis B. Stewart made strong representations to the Dean concerning the extreme difficulty of giving proper instruction in subjects connected with surveying. He needed a lecturer to help him and also a new building for instructional purposes, staff, and equipment.

In February, 1907, the Council appointed a committee to investigate and report upon the request of the Canadian Association of Clay Manufacturers that a course of instruction in clay working be instituted in the Faculty. Two months later the committee recommended that a course be established leading to the degree of B.A.Sc. Out of this came the course in Ceramic Engineering.

Before the active work of the 1907–8 session began, Dean Galbraith was selected to play for six months a leading role in one of the most important and exacting engineering investigations ever to be undertaken in Canada. On August 29, 1907, the southerly portion of the first Quebec Bridge collapsed during erection. Two days later, a Royal Commission was named to inquire into and

report upon the disaster. Along with his fellow Commissioners, Henry Holgate (Chairman) and John G. G. Kerry, Galbraith gave himself intensively to the formidable task and brought to bear those qualities of sound judgment and sympathetic consideration that had so long distinguished his work as an educational administrator. The report was finished on February 20, 1908, and on September 17 the leading American civil engineering journal, *Engineering News*, had this to say of it: "England itself, the home of royal commissions of investigation, has never, we fancy, produced a report that could fairly be set alongside the report rendered by these engineers."

Reporting on the state of the University for the academic year 1907–8, his first year of office as President, Dr. Robert A. Falconer observed that the disproportion of staff increase to student increase was especially marked in the Faculty of Applied Science and Engineering, in which the additions to staff had been mainly sessional appointments. Additions that were immediately made included T. R. Loudon, as Lecturer in Drawing, A..W. McConnell, as Lecturer in Architecture, and C. R. Young, as Lecturer in Applied Mechanics.

The President found, also, that the accommodation was inadequate. A large first year in the autumn of 1907 had made it necessary to use for drafting purposes during the early part of the session a section of the new Physics Building and a large room in the gymnasium. After Christmas, the second year was accommodated in the so-called examination hall at the rear of Convocation Hall. At the same time the space used for work in Thermodynamics and Hydraulics, still carried on in the old Engineering Building, was greatly overcrowded.

The President expressed the view that there was probably no university of the rank of the University of Toronto in which applied science was taught at such relatively small cost and with so small a staff of professors. The Province, said he, must face an increasing expenditure in this Faculty on account of the rapidly growing numbers of students and the development and complexity of industry.

The opening of the session 1908–9 brought to the staff as Associate Professor of Mining one who was to play a vital and enterprising role in the affairs of the Faculty. H. E. T. Haultain came directly from the field, full of enthusiasm and ideas. Very soon,

through his good offices, much new equipment was added to the mining laboratories. The metallurgical laboratory, however, having no sponsor, remained "almost an empty room."

Marking widespread admiration of the quality of leadership which Dean Galbraith had long given to the School and the Faculty that succeeded it was the presentation to the University of the Forster portrait of him, which for 50 years has hung near the main entrance to the Mining Building. The gift was made on November 4, 1908, in Convocation Hall by the graduates and undergraduates in Engineering.

Similarly gratifying were the presentations made to the Dean and Dr. Ellis at a huge "School" dinner held on January 27, 1909. This function coincided with the annual meeting of the Canadian Society of Civil Engineers, held in Toronto, and the notable speech given by the Dean was his retiring address as President of the Society.

In March, 1909, Professor Haultain asked for extensive changes in the curriculum for Mining Engineering. These were studied by a committee, but it was nearly a year before any revision was adopted.

During the academic year 1908–9 the Faculty was provided with a roomy and very substantial geodetic observatory to replace the small wooden structure that since 1905 had stood immediately to the south of the Engineering Building. The new quarters were provided by re-erecting east of the University College Building the stone building that had long served as the Dominion Meteorological and Magnetic Observatory before it was removed from the site of the Physics Building in 1908.

An unorthodox forecast of the breadth of employment for which the graduate engineer would be eligible is contained in Dean Galbraith's report to President Falconer for the academic year 1908–9:

> The education given in this Faculty . . . is not only suitable for candidates proposing to enter the various branches of the engineering profession, architecture, and technology, but is a very good preparation for students who intend to enter various industrial fields such as manufacturing, transportation, *etc.*, in other than technical or scientific capacities, namely as business managers, salesmen, superintendents, *etc.* In fact, the work of this Faculty bears upon the development of the resources of the country, not only through the preparation of a comparatively small number of men who will become highly trained experts, but also of those who will be required in order to carry on the every-day work of the country. This Faculty should thus furnish opportunities to those who desire a good general education suitable for industrial purposes. It will not be wise, therefore, to stiffen unduly the

requirements for entrance beyond the minimum required for the satisfactory accomplishment of the work of the curriculum. In other words, this Faculty should be prepared to admit and to train a large number of average men as well as a small number of high-class men.

With the session 1909–10 began the regular four-year course required for graduation. The year 1911 was the last one in which a diploma, indicating graduation after three successful years of study, was granted. Consequently, those entering in the autumn of 1909 did not graduate until 1913. There was no graduating class in 1912.

Significant of the growing demand for specialization was the splitting off of Electrical Engineering from Mechanical Engineering.

In one important respect definite progress was made in 1909–10 towards the relief of congestion. At last, the new building for Thermodynamics and Hydraulics was opened for use. On the other hand, usable space in the Engineering Building was seriously reduced during this session. Extensive reconstruction and renovation had to be carried out in the original part of the building erected in 1877–78. As early as June 4, 1904, Principal Galbraith had drawn the attention of the Minister of Education to the need for strengthening the walls and floors. On May 22, 1906, he had written to President Loudon informing him of the dangerous state of the old portion of the building. It was showing signs of rapid deterioration. The bricks were becoming soft, the walls had always been thin, and the masonry of the foundations was of the poorest possible character. The vibration of floors and walls arising from the movements of large bodies of students indicated a dangerous structural weakness. Galbraith suggested that an official examination of the building be made without delay by some competent authority, as the consequences of an accident might be very serious.

On June 15, 1907, he repeated his urging that something be done immediately about the needed reinforcement. At the same time he pointed out the disgraceful lack of ventilation in the crowded quarters of the old structure. This time, the question came to the attention of the new President, Dr. Robert A. Falconer, who was shortly to assume office. But even with his sponsorship, it was not until the academic year 1909–10 that the work was actually carried out.

Although there was a slight falling off in total enrolment for the session 1909–10, caused no doubt by the lengthening of the courses

to four years and the raising of the pass requirements of the Junior Matriculation prescribed for admission, the upward trend in registration was resumed in 1910–11. Intending students readily accepted the challenge of heightened standards with the feeling that what had become more difficult to obtain was the more worth having.

Opinion was growing in the Faculty that more attention should be given to non-ferrous metallurgy. The President expressed the view in his report for 1910–11 that this was the most pressing need in the Faculty at that time.

An unusual atmosphere of quietness and restraint overhung the spring term of 1910–11. Dean Galbraith fell ill and was unable to resume his active duties until the autumn term of the next session. Many years of overwork and heavy responsibility had begun to undermine an unusually robust and vigorous constitution. There were, too, disquieting heart symptoms of which the Dean said little.

Need for keeping the curriculum abreast of new developments in engineering science and the fast-growing body of professional knowledge had by this time shown the necessity of re-examining the standards of admission, to the end that students would enter with a better preparation for the heavy work of the professional courses. As early as 1908 President Falconer had suggested that the establishment of Senior Matriculation as the standard of admission would eliminate many students who otherwise would fail in the examinations of the earlier years of the courses in the Faculty. Despite this, Junior Matriculation long remained the general standard. It was announced, however, that, beginning in 1911–12, pass standing in honour Mathematics would be accepted in lieu of one of the optional subjects of Junior Matriculation. But it was not until nine years had passed that Senior Matriculation standing was to be required, and even then only in three subjects initially.

The first term of 1911–12 saw the beginning of a vigorous campaign on the part of Professor Haultain for the drastic revision of the curriculum in Mining Engineering. His contention was that the course should concentrate on engineering rather than the geological sciences. Believing that only in sharp controversy could progress be made, he urged his views upon his colleagues with energy and persistence. Council declined, however, to leave the matter of proposing the content entirely in the hands of the Profes-

sor of Mining Engineering, and appointed a committee to undertake the task. No final conclusion had been reached by the end of the session, for the Dean, in his annual report, stated that the curriculum in Mining Engineering "certainly needs revision and change."

A neglected aspect of the work of the Faculty was remedied by the appointment, in January, 1912, of George A. Guess as Professor of Metallurgy. He came to the University with a wide background of experience in metallurgical plants in British Columbia, the United States, and Peru. Under him, the Department of Metallurgical Engineering became firmly established in both the ferrous and the non-ferrous branches of that subject.

Generally, the problem of obtaining and retaining teaching staff was becoming difficult. It was proving almost impossible to offer salaries that would at all compare with the earnings of those who engaged in the actual practice of the profession.

Once more, space problems were becoming serious. For Electrical Engineering, the necessity of enlarged quarters was so urgent that expansion could not long be delayed without grave dissatisfaction arising. The Department of Applied Mechanics, also housed in the old Engineering Building, reported a similar emergency. Again, as often before, the Department of Applied Chemistry asked for a laboratory for Industrial Chemistry, as well as for more accommodation for the new work of Sanitary Engineering.

In his report for 1911–12, Dean Galbraith proposed these possible additions to existing space:

(1) A west front on the Thermodynamics and Hydraulics Building;
(2) A northerly extension of the west wing of the Mining Building for chemical laboratories;
(3) Construction of an east wing to the Mining Building to accommodate Metallurgy (both ferrous and non-ferrous) and Ceramics;
(4) A new building to replace the overcrowded Engineering Building;
(5) The addition of an intermediate floor when the collections were removed from the high-ceiling museum room in the east end of the Mining Building, thereby making an additional 7,000 to 8,000 square feet of space available.

In the hope of relieving the pressure on space, the Dean suggested that the staff might profitably consider the rearrangement of timetables so that lectures and laboratory work might be carried on in both morning and afternoon. Up till then, lectures were confined to the morning and practical work to the afternoon.

As a precursor of the eventual establishment of a graduating course in Ceramics, J. A. Keele, of the Geological Survey of Canada, was granted the privilege of conducting investigations of the clays of eastern Canada in a part of the cramped Metallurgical Engineering space during the year 1912–13. Incidentally, he gave instruction in Ceramics to a number of students.

During this session the entirely unsuitable accommodation of the Department of Electrical Engineering was forcefully drawn to the attention of the President. In the main machine laboratory it was often necessary to decide whether students should be allowed to open windows to get a breath of fresh air, or to risk injury to valuable machinery from sand blown from the road over a window sill scarcely above ground. The commonly used access to the principal machine laboratories was a passage one side of which was a walled-off coal hole. It continued to admit mud and water during wet weather, despite the efforts of the architect. During the preceding session students had complained of the alternative between foul air and colds caught from draughts in the study room for the fourth year. At that time there were 23 students, but in 1912–13 there were 36 in the same room. It was much too crowded and the men complained of the noise and its interference with their work. The room complained of had been made out of the coal hole and two adjoining store rooms in the basement, which had never been intended for class rooms.

Another protest, made jointly by the Departments of Civil and Electrical Engineering, was that their library was in the same room as the headquarters and supply department of the Engineering Society. Moreover, it was furnished with only one reading table.

One of the most effective steps that had been taken for the encouragement of advanced study and research in Applied Science was the establishment, in the spring of 1913, of the degree of Master of Applied Science.

Towards the close of the first term of 1913–14, December 5th to be exact, occurred what was perhaps the most stirring of all events that had been organized in honour of the man who, above all others, had brought the School and the Faculty to the high place it had achieved. The twenty-fifth annual dinner of the Engineering Society was chosen to mark what proved to be almost the close of a dis-

tinguished and devoted lifetime of service. Graduates came in unthought of numbers and from far places. Men of eminence spoke eloquently in praise of Dean Galbraith, of his fruitful work, of the courage, integrity, and human qualities that had made of him a great leader.

The second term came, but as it wore on the Dean's old-time energies appeared to slacken. In the spring months he was unable to attend some of the meetings of the Faculty Council—an absence from duty which must have greatly oppressed one so conscientious as he. When July came he went for rest to the family summer home at Go Home Bay. There, on July 22nd, the end came.

Few men have enjoyed the esteem, amounting almost to veneration, that was accorded John Galbraith in his lifetime. The beginning of it lay in those far-off, laborious days when single-handed he strove to bring to young men a sound conception of the fundamental scientific principles of a profession which was only then taking form in Canada. He did not seek to entertain, for his object was simply to create an understanding of the subjects under consideration. And so, convinced of the unassailability of the principles, he hammered them home by repetition and illustration. But there was nothing austere in the process, and he, as did his listeners, welcomed occasional relieving interludes. During one of his lectures on Mechanics, when he was calling attention to the directional or sense characteristic of a couple indicated on the blackboard, he paused momentarily to observe that "this couple has sense, but some haven't," an allusion that was not missed by the class.

There was complete intellectual honesty in Galbraith's teaching. If a point had been mis-stated, he called attention to the error immediately and his listeners profited doubly, in realizing that here was a man in whom no trace of guile resided.

Not many teachers of Galbraith's ability are able to appreciate the difficulties that a subject may present to the weaker students. He understood and sympathized with them. Those who were handicapped were given special attention. One distinguished early graduate of the School, who suffered from an impairment of hearing throughout his adult life, never ceased to be grateful to Galbraith for placing him in the front row and making sure that he heard and understood what was said.

Galbraith's achievements did not rest only on his success as a

teacher. He early established a personal educational philosophy from which he had no reason to depart materially throughout a long academic career. First, he made sure of what could be taught properly in an engineering school and what could not. Then, convinced of the soundness of the concept, he carried on resolutely year after year, neither seeking popularity nor fearing criticism. No decisions were made solely on the basis of his authority, and though he was at times faced with dissenting opinions, after a free exchange of views he was generally sustained. In any event, Galbraith never acted on any other basis than the one he finally thought right.

Without the paraphernalia of a modern office, he administered the affairs of the School and Faculty decisively and well. With him, it was essentially a matter of man-to-man relationships. There is but little record of conversations and arguments, either in Galbraith's correspondence or in the sixteen small diaries now in the possession of his son, John S. Galbraith. The latter are confined almost wholly to brief recordings of personal and family affairs, lectures given, dates of appointments, interviews and meetings, and the decisions reached at them. The basis of his administration was simply good faith, moderation, and a willingness to listen. Upon demonstrated wisdom, fairness, and justice had been built the unlimited trust reposed in him by staff and students.

An integrity tenoned in the rock of a strong character bred in Galbraith a profound loyalty to his friends and colleagues in fair weather and in foul. The price of it was sometimes heavy. Dr. Ellis, who knew him more intimately than anyone else, save members of Galbraith's own family, once referred to a significant instance. Believing in the soundness of Galbraith's views on engineering education, Sir George Ross had given thoroughgoing support to his plans for the development of the School. Galbraith never forgot it, and when, at the stormy close of Sir George's administration, the Opposition criticized the Government for its neglect of the University, he refused to join those who were making a strong effort to obtain directly through the Legislature a grant that the Ministers had refused for that session. Out of this attitude came a breach between Galbraith and some of his oldest friends and allies that caused him perhaps the bitterest grief which had befallen him in his entire academic career.[2]

[2]W. H. Ellis, *University Monthly* (November, 1914).

Out of his ten years of robust experience in the field before he came to the School, there had come a lively awareness of the wide variations in human nature and a corresponding philosophy of tolerance. In 1891, writing to H. E. T. Haultain, a graduate of only two years' standing, then managing a tin mine in Bohemia, he observed that although there was nothing like roughing it to make a man of one, some experiences tended to "make one believe that all men are liars and thieves." "But," he added, "the proper conclusion is that *some* men are, although the devil is not so black as he is painted"; and further, that although men in the rough struggle of life often lose the simplicity of character they possessed as boys the right sort of boy "thinks more of honour and honesty than of dollars and cents, or of learning, or of what is called success in life."

Galbraith's thoughtful mien and quiet dignity gave one a first impression of sternness and inflexibility, with no hint of the warm personality beneath. For the conventional activities of society he cared little. He was at his best, nevertheless, in a group of congenial friends, where conversation was light-hearted and jovial. To the goodwill of student and graduate dinners he responded with obvious pleasure. There, he was "Johnny," the beloved guide and mentor. Over the years he enjoyed many occasions of this kind at New York, Pittsburgh, Cleveland, Cobalt, Haileybury, and wherever sizable groups of graduates gathered. Many were his rich reminiscences and tales of the Northland. In his numerous canoe journeys, including one in 1881 from Michipicoten to Hudson Bay, and thence to the Saguenay country, he had learned much of the ways of the Indians and had acquired a working knowledge of several of their languages. Both the Ojibways and the Crees had given him Indian names. On more than one occasion he amused graduates and friends by a presentation of the prospectus of a mythical mining venture, the Skutawabo Liquid Silver Mining Company, Limited.

The story of Galbraith is one of unostentatious devotion to a task that offered but little beyond the satisfaction of having built usefully and enduringly. Sir Robert Falconer, superb judge of greatness in men, spoke of his strong and clear mind, ruled by simple but powerful principles; of his convictions that could not be shaken; of his being one of the most honest of men. These things of themselves constituted a charter to greatness.

From the sweep of the forests, from the ever enticing mysteries of lakes and streams and the creatures that inhabit them, from distance and perspective, from quiet waters and the brisk summer winds that distort the jackpines grotesquely, he annually replenished his endowment of calmness, clearness of vision, and reverence for life. To the lure of the northern lakes and the encompassing forest was added the indefinable charm of a relaxed Galbraith relating tales of Indians and fairies to children around a bonfire at his summer home in the evening.

7

THE YEARS THAT FOLLOWED

GRIEVOUS as the loss of Dean Galbraith had been, it was fortunate that an old and trusted colleague in the University service consented to set aside his personal wishes and take up the burden that had fallen from the weary shoulders of the one who had borne it for so long. William Hodgson Ellis graduated in Arts in 1867, a year before Galbraith did, and they had been closely associated for thirty-six of the ensuing years. Although Dr. Ellis was nearly sixty-nine years of age, and had early in 1914 asked to be relieved of further duty, he agreed to act as Dean until a permanent appointment could be made. When it appeared that the war would be of long duration, his appointment was made substantive.

The coming of the war of 1914–18 greatly enlarged and complicated the task that awaited the new head of the Faculty. Military activities overlaid all else. Two-thirds of the students, and many of the staff, enrolled at once in the Canadian Officers' Training Corps, or other units. Quartermaster's Stores moved into the museum space in the Mining Building, and a professor's room nearby was taken over for an orderly room. Seventy-seven undergraduates volunteered for active service.

When the time for the submission of estimates for the next academic year came, the President urged that the funds requested be no more than those necessary to maintain the departments in working order. Costly equipment and increase of space beyond that which was absolutely necessary were not to be envisaged, even though the Departments of Electrical Engineering and Applied Chemistry were in sore need of better accommodation.

By the middle of 1915, the Engineering Society was faced with a severe financial crisis. Revenues had fallen off sharply, partly because of the reduction in advertising in the monthly journal *Applied Science*, consequent upon the war, and also from the non-payment

of their annual subscriptions by 50 per cent of the graduates. Moreover, a great quantity of slow-moving stock had accumulated in the Society's store throughout the years. At the same time, expenses had been running high since 1907, when a graduate was appointed as permanent paid secretary and editor of *Applied Science*.

Drastic measures obviously had to be taken. Through the good offices of a committee of the graduates, a loan was raised to carry the Society over its immediate difficulties. But with the prospect of greatly reduced enrolment and diminished receipts, a complete reorganization of the business methods of the Society was clearly necessary. This was done. Publication of *Applied Science* stopped in August, 1915, and the paid secretary resigned shortly after.

For the session of 1915–16, the total registration was 338, down 221 from the previous year. Before the session was over, 134 students had enlisted for active service. Nevertheless, there were insistent demands for improved working conditions in Applied Mechanics and Electrical Engineering. The old Engineering Building was cold and most inconvenient. It was so filled with apparatus that some rooms were crowded by even small groups of students. To meet the large influx that would follow the conclusion of the war, authorization by the Board of Governors of the preparation of plans for a new building was urged.

In his report on the work of the session, Dean Ellis pointed out that unless the Faculty of Applied Science and Engineering exerted itself to extend the bounds of applied science, it could not hope to maintain the honourable place which it had won amongst engineering schools. It should adopt a policy of fostering and energizing research and extending the area of the organized knowledge of nature to the advantage of industry. This was not possible without financial support. Research demanded more work than could be squeezed into odd hours between the regular duties of teaching. The Dean urged that, as soon as possible, a research department, or preferably a school of engineering research, be established within the Faculty.

Towards the end of the session, and through the summer of 1916, a large part of the Engineering Building was put at the disposal of the Royal Flying Corps, an arrangement that continued into the next session.

The total number of students enrolled dropped to 193 for the

1916–17 session. Because of the enlarged demand for chemistry in war work, Chemical Engineering was the only department in which the registration increased.

A step of particular importance to the training of Civil and Mining students was taken by the Board of Governors in authorizing Professor Stewart to report on the possibility of securing an area suitable for practical surveying in a region that was not suited to agriculture. His favourable findings led later to the acquisition of the eminently suitable Gull Lake property for a survey camp.

The most important development during the 1916–17 session was the initiation of a scheme of engineering research within the Faculty. On April 10, 1917, a committee of Council recommended that a "School of Engineering Research" be established with certain definite functions, and that it should be directed by a Committee of Management. The Senate and the Board of Governors approved, and the sum of $5,000 was voted to cover the expenses of the first year of operations. Very early in the next academic year the personnel of this Board was named by Council. The chosen Secretary was the indefatigable Dr. Maitland C. Boswell, whose zeal for the promotion of research was one of the chief factors in the early success of the School.

At the opening of the 1917–18 session only 164 students enrolled. Professor Bain had gone to Washington as Chemical Adviser to the Canadian War Mission, thereby making available his expert knowledge in a field that sorely needed it. Professor Haultain was appointed in September, 1917, as Vocational Officer for Ontario under the Military Hospitals Commission, later known as the Invalided Soldiers' Commission. He appealed to the Council of the Faculty for assistance in carrying on classes for the vocational re-education of returned men, partly for therapeutic objectives and partly as preparation for a vocation. A Committee of Management for the classes was formed under the chairmanship of Professor C. H. C. Wright. To provide accommodation for Occupational Therapy, a floor was laid at main-floor level in the museum space at the easterly end of the Mining Building. Later, this was taken over by the Department of Metallurgical Engineering.

In his report on the session, Dean Ellis pointed out the extreme desirability of having plans matured for new accommodation of the Departments of Electrical Engineering, Applied Mechanics, and

Architecture. There was also great need of a laboratory for technological chemistry on a larger scale than that of any existing facilities in the Faculty. Moreover, something should be done about a ceramic laboratory.

In the regular session of 1918–19, there was a total registration of 236, but this was supplemented by the enrolment of 77 returned men in a special session beginning on February 1, 1919, and continuing until the end of June. There were 33 on first-year work, 27 on that of the second year, and 17 on work of the third year. Those successfully covering their programmes were able to enter the next higher year in September, thereby, by intensive work, saving a year in time.

At last, after forty-one years of devoted service to the School of Practical Science and the University, and with his successor found, Dr. Ellis laid aside his responsibilities at the end of June, 1919. Sir Robert Falconer, in his presidential report on the academic year just closed, spoke of the retiring Dean as one who "combining with humanism a thorough scientific knowledge is, above all, a man greatly beloved."

It was indeed true that in the early years of the great adventure of engineering education at Toronto no one was held in greater esteem and affection than Dr. Ellis. He possessed to an extraordinary degree those qualities that warmly appealed to friends, colleagues, and students. A familiarity with the humanities, gained in early life, supplemented by intense work in the sciences, had broadened his interests and extended his appreciations to a degree that made him an agreeable and entertaining companion anywhere. He was particularly at home in the open spaces, where he came into contact with things of the forests, the streams, and the hills.

Dr. Ellis possessed the ability to convey his appreciations to others. He wrote well, as is evidenced by the memorial volume of his poems, *Wayside Weeds*, published by friends after his death. He was a gifted caricaturist, who often supplemented his skill of line by aptness of versification. His chalk talks on "Animated Molecules," and other academic topics, were a fruitful source of merriment for many.

While hesitancy of speech, and uncertainty in his blackboard calculations, made of him a somewhat indifferent lecturer, he was extraordinarily effective as a speaker at dinners or on other social

occasions. However gifted an orator might precede him, students would proclaim soon, and vociferously, "We want Doctor Ellis." They persisted until they got him. Originality, unexpected turns of thought, a quick native wit, and delightful whimsicality in anecdote or Indian story were invariably intriguing.

His quickness in repartee was not impaired, but made the more effective, by a tendency to stammer. During one lecture, when Dr. Ellis was speaking of bacteria, a student asked if there was any known case of a living thing dissolving in a liquid. "Only one," said the Doctor, "and that is when a lady dissolves in tears."

With gentle sarcasm he could quell a disorderly class. One day he arrived somewhat late for a lecture, and was greeted with the traditional stamping of feet. The lecture began: "The fundamental idea of all art is rhythm. It is said that the first idea of rhythm came from a monkey swinging by his tail from a tree top."

Those who worked with him in the laboratory often remarked an unusual oddity of his behaviour, no doubt arising from concentration on the matter in hand and a tendency to stammer. The Doctor would begin a sentence, stop, go on working, and in a matter of minutes would complete the sentence from where he had left off, as if nothing had intervened.

But throughout, his engaging simplicity of mind and demeanour, with no trace of guile, made of him a friendly counsellor whose interests roamed widely and warmly encompassed those who came to him for advice and guidance.

Death came to Dr. Ellis at the home of a friend among the murmuring pines of Lake Joseph, in Muskoka, on August 23, 1920.

Since, before the death of Dean Galbraith, Dr. Ellis had expressed a desire to retire, and had stepped into the breach as Acting Dean only, the Board of Governors and the President had given immediate thought to the question of a permanent appointment. As the termination of the war seemed ever to recede, and as the choice of a new head of the Faculty was likely to fall on one who was actively engaged in the struggle, Dr. Ellis was made Dean, and the inquiry became less hurried.

Soon after Armistice Day, it became known that the new Dean was to be Charles Hamilton Mitchell, a Canadian engineer with a distinguished war record, then attached to the Intelligence Staff of the British War Office in London.

Brigadier-General Mitchell was well known in professional and academic circles. He had represented the engineering graduates of the University of Toronto on the Senate from 1901 to 1913, and had been a member of the Board of Governors from 1913 to his appointment as Dean in 1919. But as his twenty-two years of service as Dean do not lie within the scope of a volume limited to early engineering education at Toronto, the story must be left to another chronicler. So too must be the story of the administration of the seventeen years that followed.

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